Workshop / *Atelier*

Disaster Risk Financing and Insurance (DRFI)
Financement et Assurance des Risques de Désastres Naturels

Thursday-Friday, June 4-5, 2015
Jeudi-Vendredi 4-5 Juin 2015

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

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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-households transfers play an important role in coping with post-disaster losses. I first identify rural households as being most affected by weather shocks: 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 transfer. A rural shock in the previous year leads to reduced expenditure and higher probability of being poor among surrounding urban households. Therefore, while marginally effective in helping rural households cope with cyclones, relief transfers divert resources away from urban households that could have otherwise been used on productive investments.

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. Five out of the twenty million people living in the island were identified to live 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 forms of transfers.

Research question

What are the direct and indirect impacts of weather shocks on households' well-being (access to public goods, assets, income and child mortality) 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:

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

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).

Results

To estimate the impact 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, expenditure and poverty which is a broader composite measure based on assets, income and consumption and 3) a health outcome: child mortality. Since one would expect rural and urban households to be differentially impacted due to better infrastructure in urban areas and different choices of economic activities, estimation of the main regression above is always done separately for those two subgroups.

As expected and as reported in Table 1, cyclones lead to significant reduction in well-being among rural households:

- **Access to 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 %.

- **Assets:** 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:** 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:** 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.
- **Child mortality:** Cyclones occurring up to two years before the survey do not seem to have any impact on child mortality (positive but non-significant coefficient). However, the coefficient on the third year coefficient is positive and significant: a cyclone occurring three years prior to the survey leads to higher child mortality in the survey year. This suggests that income and resources might be diverted away from childcare and health as a result of a cyclone and has the indirect and longer-term consequence of higher child mortality.

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 a 8.4% higher probability of being poor and a 16.8% lower child mortality.

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 has some limitations. First, the existing categorization of reason of 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 defined the "Send relief" variable as a non-regular transfer. For both variables, I only focus on transfers that were labeled for support, support to family and others. Second, data on the other end of the transfer (sender (recipient) location for transfer recipient (sender)) 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, 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 to natural disasters.

Windspeed in the current year for the sender does not predict the probability of sending out a relief (non-regular support transfer). The expected sign here is a negative significant one, which we only see for rural households hit by a cyclone in the year before the survey: on average, being hit by a cyclone in the previous year in rural households is associated with a 7.4% lower probability of sending out a transfer. This is again consistent with the findings that rural households are more vulnerable to and strongly impacted by cyclones than urban households.

Finally, Table 3 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. Therefore, rural (urban) shocks are calculated as the average windspeed across rural (urban) communes within a district. The underlying mechanism that has to be assumed here is that ties between rural and urban households are bound within district (recall Madagascar is divided into 111 districts and 1200 communes). This is an acceptable assumption given that we do not have exact data on where exactly the transfers are going to and coming from.

As can be seen from column (1) and (2), while the coefficients of windspeed on expenditure and poverty are not significant in rural households, cyclones impacting rural areas within the same district lead to large and significant decrease in urban households' expenditure and increase in poverty. 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 unaffected. These results are not surprising given the better infrastructure seen 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. When looking at transfers however, we find that transfers to both rural and urban areas respond pretty nicely to cyclone shocks and that a very large majority of those 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. Relief transfers might therefore divert resources away from urban households that could have been invested on productive assets and investments in the current year. I do not find a similar indirect impact channel for rural households. This suggests that putting into place a SDRFI scheme in Madagascar would not only assist rural households better cope with shocks, but also relieve urban households from assuming the burden of social assistance to rural households harmed by a natural disaster.

References

- Anttila-Hughes, Jesse K., and Solomon 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 well-being

VARIABLES	(1) Electricity	(2) Solid Walls	(3) Log Exp	(4) Poverty	(5) Child Mortality
Maximum Windspeed			Panel A: Rural		
t and t-12 months	-0.001**	-0.009***	-0.005**	0.003***	-0.000
t-12 and t-24 months	0.001**	-0.009**	-0.001	0.005	0.005
t-24 and t-36 months	0.001	-0.016***	-0.005	0.005**	0.016**
			Panel B: Urban		
t and t-12 months	0.000	-0.004	-0.000	-0.002	0.001
t-12 and t-24 months	0.000	0.001	-0.001	-0.001	-0.002
t-24 and t-36 months	-0.000	-0.006	-0.001	0.004***	-0.008**

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

VARIABLES	(1) Received a transfer	(2)	(3) Sent a transfer	(4)
Maximum Windspeed	Urban	Rural	Urban	Rural
t and t-12 months	0.005***	0.003***	0.001	0.001
t-12 and t-24 months	0.001**	-0.001	0.000	-0.003***
t-24 and t-36 months	0.000	-0.000	0.001	-0.002

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. Indirect impacts of cyclones

VARIABLES	(1) Log Exp	(2) Poverty	(3) Child Mortality	(4) Log Exp	(5) Poverty	(6) Child Mortality
Maximum Windspeed		Urban			Rural	
t and t-12 months	-0.000	-0.002	0.002	-0.005**	0.004***	0.003
t-12 and t-24 months	-0.000	-0.001	-0.001	-0.001	0.006	0.005
		Rural shocks			Urban shocks	
t and t-12 months	-0.007	-0.007	-0.051	-0.007	-0.005	0.106
t-12 and t-24 months	-0.028***	0.017*	0.003	-0.003	-0.013	-0.023

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 two lags are reported here