Impact of Extreme Rainfall Days on the Households' Welfare of the Formal and Informal Sectors

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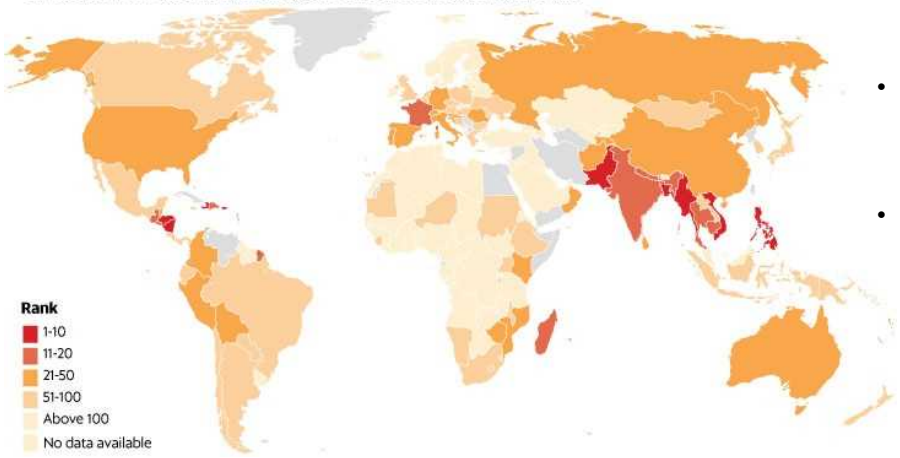
The Philippines is among the most vulnerable countries to extreme weather events in the world



- From 2011 to 2018,the Philippines ranked 3rd after Vanuatu and Tonga.
- In 2019, the country registered an improvement ranking 9th.

Source: Long-Term Climate Risk Index (CRI), 1998 to 2017,,Global Climate Risk Index 2019, page 8.

Household's welfare is negatively affected by extreme rainfall days regardless of what sector they belong

Disasters caused by natural events can push any household deeper into poverty and exacerbate inequality. However, poorer households, especially those in rural areas, are more likely to suffer from disasters and are thus more vulnerable.

These disasters increase the vulnerability of informal households to remain informal, while also increasing the risk that formal households will fall into informality.

OBJECTIVE: To assess and differentiate the impact of extreme rainfall days on the welfare of the formal and informal sectors of the economy using HH survey data

Photo credit: Louie Destacamento

- With climatic changes that are expected to result in shifting precipitation patterns.
- Understanding the impact of extreme rainfall days on the welfare of the formal and informal sectors is crucial for the appropriate design of policy instruments and social protection.

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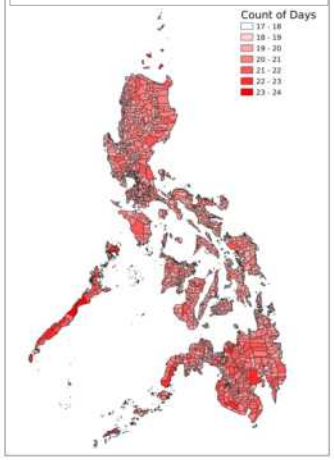
Historical rainfall extremes

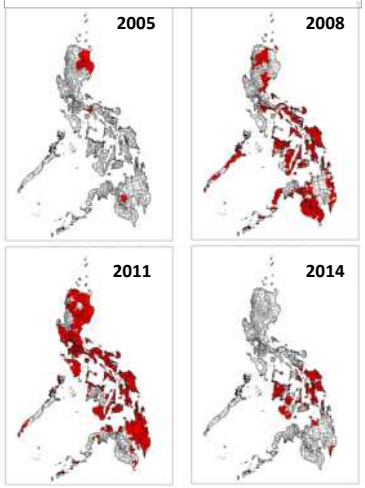
- **Extreme rainfall: rainfall ≥ 95th percentile of daily rainfall from 1998 – 2018**
- **Identifying areas with above-normal (> 75th percentile) annual number of extreme rainfall events for each year**

Data source: TRMM (Huffman et al. 2007)

Annual average number of extreme rainfall days



Areas with above-normal number of extreme rainfall days



Ravago et al.....Extreme weather events, informal and formal sectors

Who are the households in the informal sector? How big is in the informal relative to formal sector?

	Class of Work	2006	2009	2012	2015
	Formal Share (in %)	38.47	38.89	42.31	42.47
1	Private Household	1.44	1.74	1.80	2.10
2	Private Establishment	30.53	30.38	34.14	33.89
3	Government/ GOCC	6.38	6.75	6.35	6.45
4	Family-Operated, paid	0.12	0.02	0.02	0.02
	Informal Share (in %)	42.75	40.89	36.71	36.06
5	Self-Employed	35.06	33.56	30.16	30.08
6	Family-Operated, employer	6.98	6.63	6.01	5.31
7	Family-Operated, unpaid	0.71	0.70	0.54	9.67

Note that PSA does not issue official statistical counts of formal and informal households in the country; however, it defines the informal sector as those households' unincorporated enterprises. We used this definition as basis of identifying households in the formal and formal sector. Source of basic data: FIES-LFS and PSA.

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Informal households are mostly in the rural areas and most of them are poor.

Informality Share (in %)		2006	2009	2012	2015
Rural Non-poor	Formal	33	34	37	38
	Informal	49	47	42	41
Rural Poor	Formal	32	34	39	40
	Informal	59	55	50	48
Urban Non-poor	Formal	47	45	50	48
	Informal	28	28	25	26
Urban Poor	Formal	44	50	48	49
	Informal	41	34	36	34

Source: Author's Calculations using LFS data from Philippine Statistics Authority

Expenditures and income per capita are lower among households experiencing extreme rainfall.

Year		Normal, previous		Extreme, previous		P-Values			
		Formal (1)	Informal (2)	Formal (3)	Informal (4)	(1,2)	(3,4)	(1,3)	(2,4)
2006	Income	33,152	25,099	24,979	21,489	0	0.03	0	0.01
	Expenditure	27,976	21,284	20,705	17,866	0	0.01	0	0
2009	Income	35,366	31,954	29,213	24,969	0	0	0	0
	Expenditure	30,306	25,724	25,214	20,470	0	0	0	0
2012	Income	28,659	25,162	33,780	28,785	0	0	0	0
	Expenditure	22,613	19,721	28,038	22,498	0	0	0	0
2015	Income	34,132	30,489	27,243	25,423	0	0.10	0	0
	Expenditure	27,576	23,384	21,619	20,149	0	0.01	0	0

Source: Author's Calculations using FIES LFS data from Philippine Statistics Authority and weather data from Manila Observatory

For both households experiencing normal and extreme rainfall years, per capita expenditures and income are lower among informal households compared to formal households.

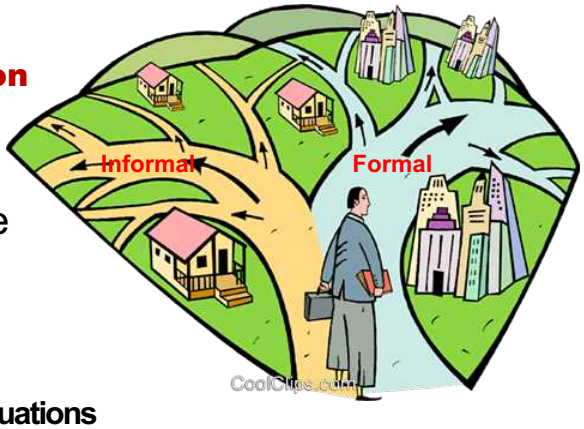
Informal households, where most of the urban and rural poor belong, tend to be in hazardous areas, increasing their disaster risk profiles.

Image Source: Typhoon Ondoy, https://tribune.net.ph/wp-content/uploads/2019/06/undoy.jpg

Empirical specification:

Endogenous switching regression

Household faces a choice between the Formal and Informal sector. The difference in the net benefits determines the sector of choice.



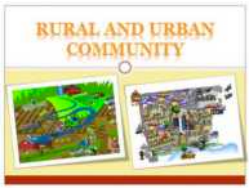
Welfare function and Selection Regime Equations

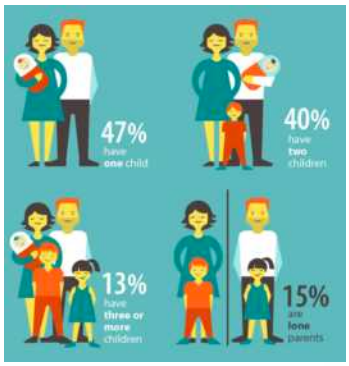
Informal	$\log Y_{Ii} = \beta_0 + \beta_1 D_{i-1} + \beta_2 D_{i-2} + \beta_3 D_{i-3} + \beta_4 \boldsymbol{X}_i + z_{Ii}$
Formal	$\log Y_{Fi} = \beta_0 + \beta_1 D_{i-1} + \beta_2 D_{i-2} + \beta_3 D_{i-3} + \beta_4 \boldsymbol{X}_i + z_{Fi}$

$$\boldsymbol{I_i}^* = \boldsymbol{\delta}(\log \boldsymbol{Y_{Ii}} - \log \boldsymbol{Y_{Fi}}) + \boldsymbol{\gamma Z_i} + \boldsymbol{\epsilon_i}$$

Empirical specification

Sector selection variables include urban-rural municipality classification and being poor or non-poor and HH characteristics.





Disaster variable and vector of household characteristics include sex, age, square of the age, marital status, and educational attainment of the household head, as well as household size.

Model	OLS	Endogenous Switching Regression: EXPENDITURE			OLS	Endogenous Switching Regression: INCOME		
			Formal	Informal			Formal	Informal
Dependent Variable	Log (Per Capita Expenditure)	Informality	Log (Per Capita Expenditure)		Log (Per Capita Income)	Informality	Log (Per Capita Income)	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Informality (1/0)	-0.067***				-0.069***			
	(0.004)				(0.004)			
Extreme days count lag (1/0)	-0.096***	-0.125***	-0.162***	-0.106***	-0.084***	-0.132***	-0.172***	-0.119***
	(0.010)	(0.013)	(0.010)	(0.009)	(0.010)	(0.013)	(0.011)	(0.011)
Extreme days count lag 2 (1/0)	-0.197***	0.100***	-0.177***	-0.107***	-0.162***	0.076***	-0.157***	-0.064***
	(0.011)	(0.013)	(0.010)	(0.010)	(0.011)	(0.013)	(0.010)	(0.011)
Extreme days count lag 3 (1/0)	-0.027**	-0.143***	-0.113***	-0.077***	0.037***	-0.113***	-0.046***	-0.009
	(0.011)	(0.015)	(0.011)	(0.011)	(0.011)	(0.015)	(0.012)	(0.012)
Sex of HH (1/0)	-0.126***	-0.226***	-0.204***	-0.204***	-0.148***	-0.217***	-0.233***	-0.241***
	(0.007)	(0.013)	(0.010)	(0.009)	(0.007)	(0.013)	(0.011)	(0.011)
Age of HH	0.019***	0.000	0.024***	0.033***	0.021***	0.008***	0.029***	0.034***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Age of HH Squared	-0.000***	0.000***	-0.000***	-0.000***	-0.000***	0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Marital Status of HH	-0.012*	-0.181***	-0.075***	-0.136***	-0.019***	-0.184***	-0.093***	-0.163***
	(0.006)	(0.013)	(0.009)	(0.009)	(0.007)	(0.012)	(0.010)	(0.011)
Educ. Attainment of HH	0.494***	0.022***	0.645***	0.384***	0.509***	0.068***	0.721***	0.370***
	(0.005)	(0.007)	(0.005)	(0.006)	(0.005)	(0.007)	(0.006)	(0.006)
Household Size	-0.083***	-0.055***	-0.141***	-0.114***	-0.076***	-0.067***	-0.150***	-0.115***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)
Poverty Indicator (1/0)	-0.769***	0.831***			-0.957***	0.953***		
	(0.004)	(0.006)			(0.004)	(0.006)		
Urban Municipality dummy (1/0)		-0.445***				-0.339***		
		(0.005)				(0.005)		
Constant	10.712***	0.366***	11.236***	9.433***	10.430***	0.146*	10.992***	9.083***
	(0.057)	(0.082)	(0.062)	(0.059)	(0.057)	(0.080)	(0.068)	(0.068)
R-squared	0.537				0.554			
sigma			-0.767	0.762			0.803	0.889
rho			0.805	0.947			0.814	0.972
Observations	125,553	125,553	125,553	125,553	125,553	125,553	125,553	125,553
LR test of indep. eqns. :		chi2(2) = 32186.05 Prob > chi2 = 0.0000				chi2(2) = 25885.27 Prob > chi2 = 0.0000		

standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

What factors influence HHs to be informal?

Model	OLS	Endogenous Switching Regression: EXPENDITURE			OLS	Endogenous Switching Regression: INCOME		
			Formal	Informal			Formal	Informal
Dependent Variable	Log (Per Capita Expenditure) (a)	Informality (b)	Log (Per Capita Expenditure) (c)	(d)	Log (Per Capita Income) (e)	Informality (f)	Log (Per Capita Income) (g)	(h)
Poverty Indicator (1/0)	-0.769*** (0.004)	0.831*** (0.006)			-0.957*** (0.004)	0.953*** (0.006)		

Being poor significantly affects the likelihood that HHs will be informal.

Model	OLS	Endogenous Switching Regression: EXPENDITURE			OLS	Endogenous Switching Regression: INCOME		
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Dependent Variable	Log (Per Capita Expenditure) (a)	Informality (b)	Log (Per Capita Expenditure) (c)	(d)	Log (Per Capita Income) (e)	Informality (f)	Log (Per Capita Income) (g)	(h)
Urban Municipality dummy (1/0)		-0.445*** (0.005)				-0.339*** (0.005)		

Being considered as urban inversely affects the likelihood that HHs will be informal.

Model	OLS	Endogenous Switching Regression: EXPENDITURE			OLS	Endogenous Switching Regression: INCOME		
			Formal	Informal			Formal	Informal
Dependent Variable	Log (Per Capita Expenditure) (a)	Informality (b)	Log (Per Capita Expenditure) (c)	(d)	Log (Per Capita Income) (e)	Informality (f)	Log (Per Capita Income) (g)	(h)
Informality (1/0)	-0.067*** (0.004)				-0.069*** (0.004)			

- **OLS** estimates show that informal households have lower incomes and expenditures.
- Results show that being informal relative to formal sector decreases expenditure and income by around 7 percent, respectively, holding other things constant.

Model	OLS	Endogenous Switching Regression: EXPENDITURE			OLS	Endogenous Switching Regression: INCOME		
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Dependent Variable	Log (Per Capita Expenditure)	Informality	Log (Per Capita Expenditure)		Log (Per Capita Income)	Informality	Log (Per Capita Income)	
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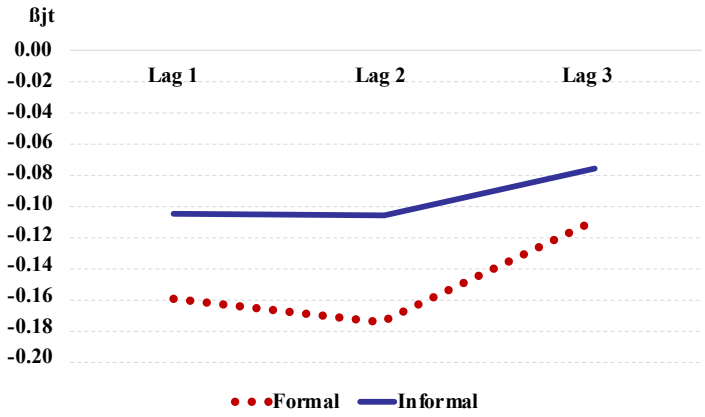
	(0.011)	(0.015)	(0.011)	(0.011)	(0.011)	(0.015)	(0.012)	(0.012)

- **FIML estimates show that extreme rainfall adversely affects HH welfare. Extreme rainfall days significantly lowers expenditure of households in the formal and informal sectors by 16.2 and 10.6 percent, respectively.**
- **When income is used as welfare indicator, the negative impact is slightly bigger at 17.2 percent for formal and 11.9 percent for the informal households.**
- **The coefficients of the two- and three-year lagged extreme rainfall variable are all negative and significant, with the magnitude getting smaller the earlier the experience of extreme rainfall.**

The formal sector recovers faster than the informal sector.



- **The dotted line is more negative than the solid line.**
- **The slope of the lines can be interpreted as the speed of recovery.**

Lag distribution of the extreme rainfall days variable, D_{ji-t}, (with expenditure as the welfare indicator).

- **Households in the formal sector has larger income and has more to lose than the households in the informal sector.**
- **However, the adverse impact to the informal households may be irreversible given their weak capability to recover and their limited ability to smooth out consumption even during days with normal rainfall.**

Image Source: Typhoon Haiyan, https://www.pri.org/stories/2013-11-11/damage-typhoon-haiyan-left-philippines-photos

Actual vs Counterfactual comparisons

Conditional expectation, treatment and heterogeneity (Income as Dependent Variable)					
Subsample	Decision Stage			Treatment effects	
	Informal	Formal			
Informal HH	(a) 19,580	(c) 21,488		TT	-1,909
Formal HH	(d) 5,087	(b) 56,587		TU	-51,500
Heterogeneity Effects	BH_I 14,493	BH_F -35,099		TH	49,591

- **Cells a vs. c - Households who are in the informal sector have income lower by PhP 1,909 compared to a counterfactual case had they choose the formal sector.**
- **Cells b vs. d - where the counterfactual of formal households is had they choose the informal sector. The households in the formal sector would have income lower by PhP 51,500 if they choose to be in the informal sector.**
- **These results imply that income of households choosing informal sector is further decreased in the presence of weather shock.**
- **Transitional heterogeneity effect at PhP 49,591 is positive, which implies that the effect is significantly higher for the households that choose to be in the informal sector compared to those households that did not.**

Concluding Remarks

- Households, regardless of which sector they belong, reels from the negative effects of experiencing extreme rainfall from three years ago up to a year ago.
- Weak capability to recover and the limited ability to smooth out consumption even during days with normal rainfall makes extreme weather events adversely potent for the welfare of the informal households.
- Targeted social protection coverage to households near the poverty line can help soften the blow of a weather shocks:
  - Improving the informal sector access to opportunities for smoothing consumption
  - Policies on poverty alleviation should include attention to its stochastic aspects
  - Awareness/Education campaign re impact of disasters

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POLICY BRIEF

No. 2020-24 (October 26, 2020)

Impact of Extreme Rainfall Days on the Well-being of the Households in the Formal and Informal Sectors

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The Philippines is among the most vulnerable countries to extreme weather events in the world. The geographical location of the country in the tropics and in the Pacific makes it highly exposed to extreme weather events such as typhoons, storm surges, intense flooding among others (e.g. Cinco et al. 2016). Since 2011, the World Risk Report has consistently ranked the Philippines among the top three countries in the world at high disaster risk, along with Vanuatu and Tonga, but has recently been ranked ninth since 2019 .

Impact of extreme rainfall days on the well-being of households in the formal and informal sectors

By Majah-Leah V. Ravago., Gerald Gracius Pascua, Loubill Dayne Aceron, Emilio Gozo, Faye Cruz and Gemma Narisma

November 27, 2020

https://businessmirror.com.ph/2020/11/27/impact-of-extreme-rainfall-days-on-the-well-being-of-households-in-the-formal-and-informal-sectors/

EAGLE WATCH

The Philippines is among the most vulnerable countries to extreme weather events in the world. The geographical location of the country makes it highly exposed to extreme weather events such as typhoons, storm surges, intense flooding, among others. The World Risk Report has consistently ranked the Philippines among the top 3 countries in the world at high disaster risk, along with Vanuatu and Tonga.

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PHILIPPINES

Maraming Salamat Po!

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COASTAL CITIES AT RISK IN THE PHILIPPINES
Investing in Climate and Disaster Resilience