When It Rains, It Pours? Analyzing the Rainfall Shocks-Poverty Nexus in the Philippines

Connie B. Dacuycuy and Lora Kryz Baje

October 1, 2019

Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

Motivation

Many studies on poverty in the Philippines, but most use cross-section datasets.

Few have used data with time elements (Reyes et al, 2010; Mina and Imai, 2016).

Chronic and transient poverty and rainfall shocks analysis

21.6% (2015)

16.1% (2018)

Relevance of the study

1

Weather: integral part of our life

PH: most vulnerable to risks can lose the most from disasters and extreme weather events

2

Weather shocks:

-implications on income and expenditures

-reduction of wages and salaries (informal workers)

3

Weather shocks:

-easily affect the poor due to constraints on credit, savings, and human and social capital

Data

- 2003, 2006, and 2009 Family Income and Expenditure Survey (FIES)
- PAGASA weather data
- Poverty thresholds

FIES data

2003, 2006, 2009 FIES can be merged to form a panel dataset. Master sample based on the Census of Population and Housing.

Household ID: region, province, municipality, *barangay*, enumeration area, sample housing unit serial number and household control number.

6517 samples that are common to the 6 datasets.

HH members may differ (house for rent)

Samples are further limited to households:

-HH head's sex should be the same throughout the period

-HH head's age should be consistent

2715 samples

2009 weights

Weather data

-average rainfall (in millimeters)

50 PAGASA weather stations

Map the weather information with the FIES dataset: province of residence as the merging variable

83 provinces in the dataset.

Weather data (Issues)

1. Some provinces host multiple weather stations (WS).

Selected WS that is located in or in close proximity to the provincial capital. Palawan province has three stations: Coron, Cuyo and Puerto Princesa.

2. Some provinces have no weather station.

Mountain Province, La Union and Ifugao - assigned WS in Baguio City, Benguet

Tarlac- assigned WS in Cabanatuan, Nueva Ecija

Without WS assignments, 28 provinces (658 households) will be dropped

Air/straight distance between the capital and the nearby WS is determined using http://distancecalculator.globefeed.com/Philippines_Distance_Calculator.asp

10, 40, 60, 80 kms

Weather data

24 provinces have WS

57 that are assigned nearby WS

2 (Guimaras and Batanes) that could not be reasonably mapped

normal: 30-year average, compiled for the period 1971-2000

-Sum up rainfall data (current and normal) in each year (1998-2009).

-Generated the SD

-Generated the z-score (total_rain-total_norm)/SD

binary proxies for shocks: 1 SD above,1 SD below, and 2 SD below the normal rainfall.

Chronic and transient poverty

Spells approach (Lillard & Willis, 1978): focuses on transitions from one welfare status to another

effectively derives the ‘distribution of time spent poor’

Components approach (DAG 2010):

focuses on estimating the transitory and permanent components of welfare

Does not identify transient poverty as simply crossing the poverty line

Avoids arbitrary assignment of chronic poverty (4/5 or 3/5?)

Some HHs are below but very near the poverty threshold

Total poverty and its components

	Observations	Per capita expenditure against poverty threshold (Total)	Per capita food expenditure against food threshold (Food)
		% of total poverty	% of total food poverty
National: Chronic	2675	92	92
Transient		8	8
Rural:Chronic	1672	93	94
Transient		7	6
Urban: Chronic	1003	88	88
Transient		12	12

Authors' calculations based on the merged 2003-2009 FIES dataset.

RRL: Weather shocks-welfare nexus

- TS Agatha in Guatemala, per capita consumption in urban areas has decreased--5.5 PP **increase in poverty** (Baez et al,2015)
- Delay in the onset of monsoon **decreases in the welfare of rice farm households** (Skoufias et al, 2012)
- PH: extreme weather events exacerbates inequality, weather shocks decreases consumption (Bayani-Arias and Palanca-Tan, 2017; Safir et al, 2013)

Theoretical Framework

Maximization problem : $\bar{u}_x = \bar{u}_x(Q_x, b_x, z, s, \varepsilon)$ st $p_x Q_x + z \leq y$

Q is a vector of consumption goods, *z* is a numeraire, *b* is a vector of characteristics of *Q*, *s* is a vector of household characteristics and *e* is an unobservable component.

Conditional indirect Utility function: $\bar{v}_x(p_x, b_x, y, s, e) = \bar{u}_x[\bar{Q}_x(p_x, b_x, y, s, e), b_x, z(p_x, b_x, y, s, e), s, e]$

Applying Roy's identity : $\bar{Q}_x(p_x, b_x, y, s, e) = -\dfrac{\partial \bar{v}(p_x, b_x, y, s, e)/\partial p_x}{\partial \bar{v}(p_x, b_x, y, s, e)/\partial y}$

Conditional demand for good *x* : $\bar{Q}_x(p_x, b_x, y, s, e)$

$\bar{Q}_x$ proxied by household expenditures

More informative research is to analyze how consumption, $\bar{Q}_x$, relative to a threshold responds to weather shocks

Empirical Strategy

$$q_i^w = \alpha_i + \delta Y_i + \phi k_i + \varepsilon_i$$

- q represents poverty (w=transient or chronic), Y is income, k (head's age, gender, educational attainment, and marital status; an indicator if the respondent(spouse) is always employed, indicators for the presence of underschool-age children, regional dummies), and iid error

OLS assumption: $\mathrm{cov}(Y, \varepsilon) = 0$ is **violated**.

: bias arising from **endogeneity** (unobservable characteristics (e.g. IQ) likely to determine income)

IV: $Y_i = \varphi_i + \gamma rainfall shock + \phi k_i + e_i$

$$q_i^w = \alpha_i + \delta \hat{Y}_i + \phi k_i + \varepsilon_i$$

exploits the exogeneity of weather variations to establish the causality

Table 3: First stage estimates, effects of rainfall shocks on wages and incomes (10 kms)

First stage estimates	Agri wage PC	NAgri wage PC	EYPC: Services	EYPC: Industry	EYPC: Agri
Rural	-0.458**	-0.688***	-0.708**	-0.119	0.436**
	[0.206]	[0.141]	[0.333]	[0.276]	[0.194]
1 SD above normal	1.049***	0.363	0.42	2.475***	-0.772
	[0.345]	[0.669]	[0.709]	[0.852]	[0.656]
1 SD below normal	0.393	-0.094	0.405	1.311***	0.505
	[0.463]	[0.363]	[0.573]	[0.412]	[0.415]
2 SD below normal	0.174	0.952*	-1.194	1.425	0.852***
	[0.938]	[0.540]	[0.899]	[1.119]	[0.256]
Rural*1 SD above normal	-0.556	-0.09	-0.219	-1.906*	0.657
	[0.441]	[0.690]	[0.864]	[1.001]	[0.667]
Rural*1 SD below normal	-0.223	-0.039	-0.578	-1.186***	-0.710*
	[0.453]	[0.324]	[0.532]	[0.415]	[0.414]
Rural*2 SD below normal	1.741***	-0.634	1.850**	-1.565*	-1.169***
	[0.473]	[0.474]	[0.862]	[0.923]	[0.316]
N	357	776	296	471	591
Testing marg eff of rainfall shock-rural dummy					
Rural + 1 SD above normal = 0	-1.014***	-0.778	-0.928	-2.025**	1.092*
	[0.372]	[0.677]	[0.791]	[0.967]	[0.641]
Rural + 1 SD below normal = 0	-0.681*	-0.727**	-1.287***	-1.305***	-0.274
	[0.405]	[0.292]	[0.431]	[0.302]	[0.368]
Rural + 2 SD below normal = 0	1.283***	-1.322***	1.142	-1.684*	-0.116
	[0.438]	[0.452]	[0.812]	[0.882]	[0.326]

Table 4: Second stage estimates, effects of wages and incomes on chronic and transient poverty (10kms)

	Chronic		Transient	
	Total poverty	Food poverty	Total Poverty	Food poverty
Agri wage PC	**-0.233*** **	**-0.162*** **	0.003	0.009
	[0.039]	[0.044]	[0.004]	[0.003]
Underidentification test§	**0.009**	**0.009**	0.009	0.009
Overidentification test§§	**0.455**	**0.502**	0.032	0.771
NAgri wage PC	**-0.165*** **	**-0.183*** **	**-0.005*** **	0.003
	[0.026]	[0.029]	[0.002]	[0.002]
Underidentification test§	**0**	**0**	**0**	0
Overidentification test§§	**0.39**	**0.35**	**0.614**	0.165
EYPC: Services	**-0.115*** **	**-0.129*** **	-0.004	0.001
	[0.027]	[0.036]	[0.003]	[0.003]
Underidentification test§	**0.028**	**0.028**	0.028	0.028
Overidentification test§§	**0.575**	**0.391**	0.357	0.662
EYPC: Industry	**-0.105*** **	**-0.110*** **	-0.003	0.002
	[0.024]	[0.025]	[0.002]	[0.002]
Underidentification test§	**0**	**0**	0	0
Overidentification test§§	**0.446**	**0.313**	0.298	0.366
EYPC: Agri	0.158**	0.106**	-0.008*	0.001
	[0.062]	[0.050]	[0.005]	[0.004]
Underidentification test§	0.215	0.215	0.215	0.215
Overidentification test§§	0.027	0.005	0.102	0.358

§p-values. Tests H0 that the instruments are relevant

$$cov(inst, endog\ var) = 0$$

Rejection of the null implies that the instrument induces change in the endogenous variable.

§§ p-values. Tests H0 that the instruments are uncorrelated with the error term,

$$cov(instrument, error\ term) = 0$$

and that the excluded instruments are correctly excluded from the estimated equation. Rejection of the null implies that the instruments are valid.

Takeaways

- **Exploits the exogeneity of rainfall shocks**
  - Rainfall shocks are valid instruments for various wages and incomes.
  - Shocks adversely affect wages and incomes.
  - Wages and income decreases chronic and transient poverty.
- **Demonstrates**
  - The use nationally representative data to analyze the weather shocks-poverty nexus
  - The importance of panel data to analyze poverty

Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

Service through policy research

Thank you!


/PIDS.PH


@PIDS_PH


http://www.pids.gov.ph