

An Employment Guarantee as risk insurance?

Assessing the effects of the NREGA on agricultural
production decisions

Esther Gehrke

University of Passau & German Development Institute

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Motivation (1)

Small and medium scale farmers seem to be heavily constrained in their production and investment decisions (Duflo et al. 2008, Foster and Rosenzweig 2010, Dercon et al. 2011)

- ▶ delayed technology adoption
- ▶ lack of investment in productive capital
- ▶ conservative crop choices

Potential explanations...

- ▶ learning processes (Besley and Case 1993; Munshi 2004; Conley and Udry 2010)
- ▶ lack of human capital (Foster and Rosenzweig 1996)
- ▶ risk / uncertainty (Rosenzweig and Binswanger 1993; Dercon 1986; Dercon and Christiaensen 2011; Karlan et al. 2012)
- ▶ credit constraints (Rosenzweig and Wolpin 1993; Fafchamps and Pender 1997; Gine and Klonner 2006)

Motivation (2)

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A model of household
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Data

Estimation Strategy

Summary statistics

Results

Conclusions

Empirical evidence about the role of uninsured risks scarce....

- ▶ Evaluating access to micro-insurance products could provide evidence...
 - ▶ Low take-up rates (Cole et al. 2012)
 - ▶ Mixed evidence on productivity effects (Karlan et al. 2012)
- ▶ Explore other policies, such as public works programmes/ employment guarantees?

Research question

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To which extent can an employment guarantee such as the National Rural Employment Guarantee Act (NREGA) in India improve households' ability to manage risks?

- ▶ Can an employment guarantee help households' to cope with shocks and does this affect their expectations of risk management?
- ▶ Does the access to the NREGA affect households production decisions, in particular crop choice?

The National Rural Employment Guarantee Act

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1. NREGA is the largest public works programme in the world...
 - ▶ entitles every household in rural areas to 100 days of work per year
 - ▶ provides work to close to 55 Million households (2011-12)
 - ▶ 4% of total government spending (2011-12)
2. Sequenced introduction (2006 - 2008), most “backward” districts should introduce NREGA first
3. Highly political: Prioritization of poorest districts was not systematically implemented

Effects of the NREGA

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1. Income effect: increases in available income upon participation in the programme
 - ▶ consumption levels (Jha, Gaiha and Pandey 2012)
 - ▶ expenditure for education (Afridi, Mukhopadhyay and Sahoo 2012)
 - ▶ women empowerment (Pankaj and Tankha 2010)
2. General equilibrium effects, i.a. on wage levels (Imbert and Papp 2012, Berg et al. 2012; Basu 2013)
3. Insurance effect: “right to work” influences households’...
 - ▶ ability to smooth income in case of a shock
 - ▶ expectation and risk management
 - ▶ willingness to take risks (crop choice, investment)
 - ▶ reduce precautionary savings

Why crop choice?

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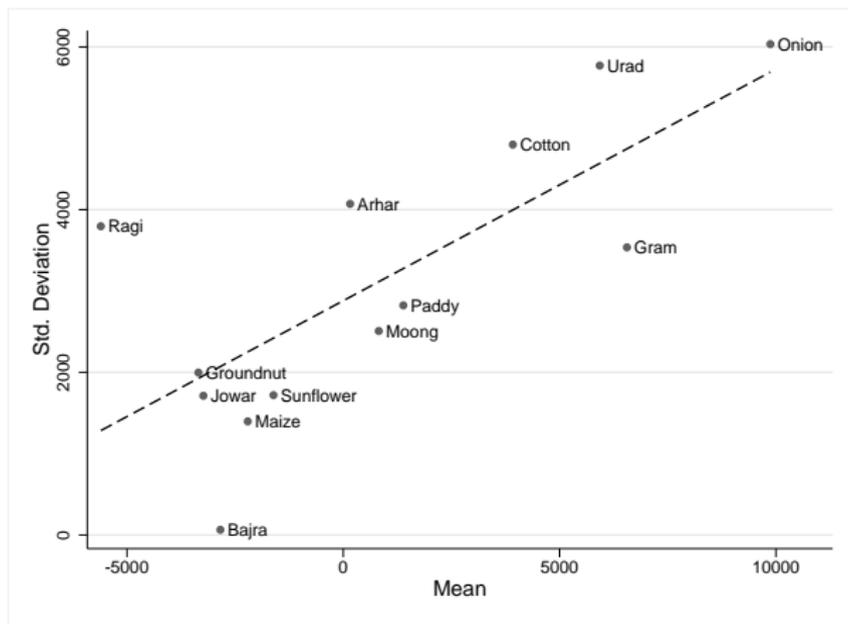
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Figure : Returns per Hectare for selected crops in Andhra Pradesh



Source: Cost of Cultivation Statistics, Ministry of Agriculture, Gol

A model of household crop choice under risk

General set-up

- ▶ Household maximises utility from consumption
- ▶ Household is risk averse: $\partial U / \partial C > 0$ and $\partial^2 U / \partial C^2 < 0$
- ▶ Household generates income from agricultural production Q and wage employment wT
- ▶ Two agricultural products Q^d and Q^s :

$$Q^d = f^d(a^d, l_1^d, i^d)$$

$$Q^s = f^s(a^s, l_1^s, i^s, \epsilon) \quad E[\epsilon] = 1$$

$$\alpha(Q^d + Q^s) = l_2$$

- ▶ Two periods: Planting and Harvesting
 1. Planting season
 - a. Allocation of land a , labour l_1 and inputs i
 - b. Shock realizes
 2. Harvesting season: Yield can be harvested with l_2
- ▶ Harvest stage wages w_2 covary with ϵ

A model of household crop choice under risk

Decision rules

$$\max V = U_1(C_1) + \delta EU_2(C_2)$$

s.t.

$$C_1 \leq w_1(T_1 - I_1^d - I_1^s) - g(i^d + i^s) + B$$

$$C_2 \leq (p - \alpha w_2^r)(Q^d + E(Q^s)) + E(w_2)T_2 - (1 + r)B$$

$$B \leq B^m$$

$$a^d + a^s \leq 1$$

Decision rules for input allocation to both crops:

$$\frac{\partial f^d}{\partial i^d} = \frac{g}{(p - \alpha w_2^r)} \frac{\frac{\partial U_1}{\partial C_1}}{\delta \frac{\partial EU_2}{\partial C_2}}$$

$$\frac{\partial f^s}{\partial i^s} = \frac{g}{(p - \alpha w_2^r)} \frac{\frac{\partial U_1}{\partial C_1}}{\delta \frac{\partial EU_2}{\partial C_2}} - \frac{\text{cov}(\frac{\partial U_2}{\partial C_2}, \epsilon)}{(p - \alpha w_2^r) \delta \frac{\partial EU_2}{\partial C_2}}$$

A model of household crop choice under risk

Potential impact of the NREGS

NREGA increases expected harvest stage wage levels $E(w_2)$

- ▶ Without uncertainty, this reduces input allocation to both crops:

$$\frac{\partial f^s}{\partial i^s} = \frac{g}{(p - \alpha w_2^r)} \frac{\frac{\partial U_1}{\partial C_1}}{\delta \frac{\partial U_2}{\partial C_2}}$$

- ▶ With uncertainty, this increases the allocation of inputs to the risky crop relative to the safe crop:

$$\frac{\partial f^s}{\partial i^s} = \frac{g}{(p - \alpha w_2^r)} \frac{\frac{\partial U_1}{\partial C_1}}{\delta \frac{\partial EU_2}{\partial C_2}} - \frac{\text{cov}(\frac{\partial U_2}{\partial C_2}, \epsilon)}{(p - \alpha w_2^r) \delta \frac{\partial EU_2}{\partial C_2}}$$

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Employment Guarantee
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Young Lives Survey (YLS) data for Andhra Pradesh

- ▶ 3019 households, 6 districts
- ▶ 3 rounds of interviews: 2002, 2007 and 2009
- ▶ NREGA Phase I: 4 districts; Phase II & III: 2 districts

Sample: Households with non-zero agricultural production in 2007 and 2009 → 1118 households (2236 observations)

Estimation Strategy

Model:

$$i_{it}^s / (i_{it}^d + i_{it}^s) = \beta_0 + \beta_1 D_{it} + \beta_2 X_{it} + u_i + v_{it}$$

Dependent variable:

- ▶ Share of inputs allocated to risky crops (e.g. cotton)

Explanatory variable:

- ▶ Introduction of the NREGA at district level
- ▶ Treatment intensity at sub-district (mandal / block) level
- ▶ Households' self selection into the NREGA

Control variables:

- ▶ Variable inputs, Area cultivated, Irrigated area, Annual income (off-farm activities), Household wealth, Rainfall (deviation, lag)

Summary statistics (1)

Table : General household characteristics

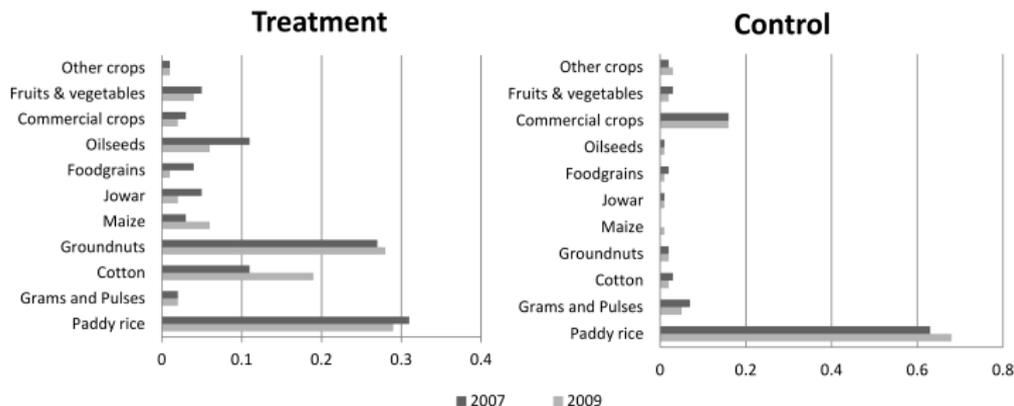
	Treatment		Control	
	2007	2009	2007	2009
Male household head	0.96 (0.20)	0.96 (0.21)	0.97 (0.17)	0.96 (0.20)
Age of hh head	41.92 (12.11)	41.54 (10.40)	40.76 (11.63)	41.32 (9.73)
Household size	6.10 (2.62)	5.99 (2.75)	5.57 (2.01)	5.47 (1.99)
Household head is literate	0.33 (0.47)	0.33 (0.47)	0.25 (0.43)	0.25 (0.43)
Household registered with NREGA	0.66 (0.47)	0.76 (0.43)	0.00 (0.00)	0.78 (0.41)
Annual income, NREGA	1.28 (2.49)	3.78 (5.12)	0.00 (0.00)	4.16 (5.00)
Annual income, off-farm activities	26.67 (27.17)	46.48 (52.42)	21.02 (27.69)	34.39 (38.66)
Value of agr. production	30.18 (48.62)	48.49 (80.27)	25.05 (12.98)	35.22 (135.00)
Any serious debts	0.63 (0.48)	0.40 (0.49)	0.47 (0.50)	0.27 (0.45)
Area cultivated (acres)	4.17 (4.72)	4.26 (4.32)	2.67 (5.39)	2.54 (3.25)
Observations	769	769	349	349

Notes: Nominal values in 1000 Rs.

Standard deviation in parentheses.

Summary statistics (2)

Figure : Allocation of inputs to different crops (sample means)



Source: Own calculation, Young Lives Survey

Results (1)

Does the NREGS affect input allocation?

Table : Inputs allocated to Cotton (Fixed Effects)

	(1)	(2)	(3)	(4)
NREGA	0.088** (0.032)			
NREGA registered in 2006		0.094* (0.036)		
Cumulative expenditure NREGA (log, April 2008)			0.041* (0.015)	
Persondays per Jobcard generated (2007-08)				0.007*** (0.002)
Controls	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes
Region-year dummies	No	No	Yes	Yes
Observations	2236	2236	2236	2236

Entropy balancing used for identification in col. (2)

Clustered standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results (2)

Specific trends in treatment districts?

Table : Inputs allocated to Cotton in Phase I districts only (Fixed Effects)

	(1)	(2)	(3)
NREGA registered in 2006	0.061 ⁺ (0.043)		
Cumulative expenditure NREGA (log, April 2008)		0.106** (0.031)	
Persondays per Jobcard generated (2007-08)			0.008*** (0.002)
Controls	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes
Region-year dummies	No	Yes	Yes
Observations	1540	1540	1540

Entropy balancing used for identification in col. (2)

Clustered standard errors in parentheses

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results (3)

Heterogeneity of treatment effects?

Motivation

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Employment Guarantee
ActA model of household
crop choice under risk

Data

Estimation Strategy

Summary statistics

Results

Conclusions

Table : Inputs allocated to Cotton (Fixed Effects)

	Coefficient	Marginal Effect
NREGA registered in 2006	0.111**	0.102
1.NREGA#Rainfall	-0.279**	
Controls	Yes	
Time dummy	Yes	
Observations	1540	

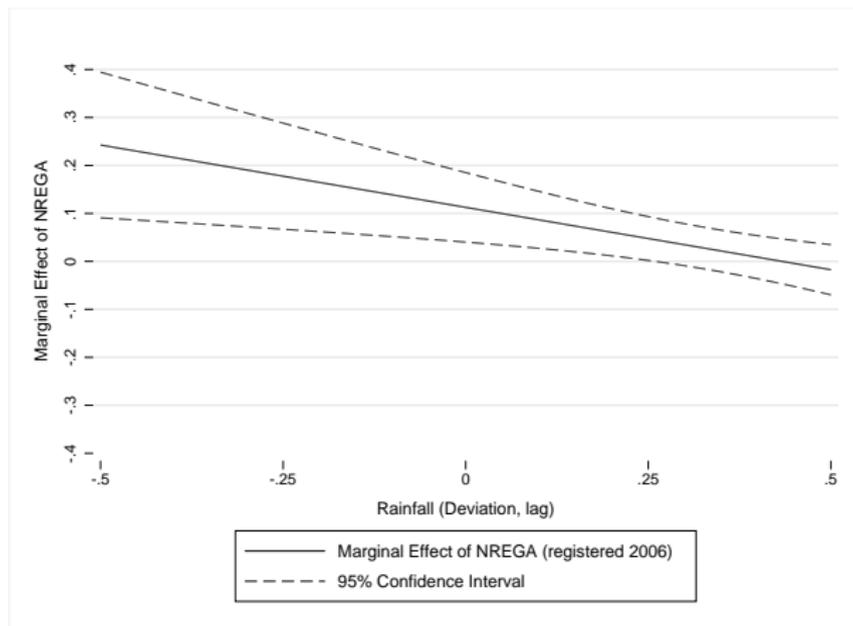
Phase I districts only.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results (4)

Visualizing the interaction effect

Figure : Marginal effect of NREGA on inputs allocated to cotton



Conclusions

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Data

Estimation Strategy

Summary statistics

Results

Conclusions

1. Risk constrained households choose suboptimal production strategies
2. NREGA reduces households' risk exposure by guaranteeing employment opportunities in areas and time periods where they previously did not exist
3. NREGA enables households to cultivate more profitable crops, which can considerably increase their income from agricultural production

Thank you for your attention!

Annex

Does the NREGA help households cope with shocks?

Table : Number of days worked with NREGS (Fixed Effects)

	NREGS days	NREGS days (log)
Rainfall (deviation, lag)	-53.027* (22.993)	-1.753*** (0.317)
Rainfall (deviation)	-25.222** (9.173)	-0.665*** (0.179)
Area cultivated (acres, log)	3.963 (2.849)	0.050 (0.059)
Wealth index	-8.982 (25.561)	-0.074 (0.545)
Year 2009 (dummy)	54.501*** (12.044)	1.643*** (0.183)
Constant	26.047* (11.984)	2.575*** (0.256)
Observations	941	941

Clustered standard errors in parentheses

Self reported shocks included, but not reported

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Annex

Profitable crop choices?

Table : Agricultural Production Function (Fixed Effects)

Dep. var.: Value of agricultural production (log)	(1)	(2)
Variable inputs (log)	0.555***	(0.040)
Area cultivated (acres, log)	0.093**	(0.034)
Irrigated area (% of total)	0.089	(0.101)
Fertilizer (dummy)	-0.108	(0.157)
HYV seeds (dummy)	0.074	(0.047)
Share inputs: Cotton	0.327*	(0.129)
Share inputs: Groundnuts	-0.287*	(0.130)
Share inputs: Oilseeds	-0.563**	(0.188)
Share inputs: Commercial crops (excl. cotton)	0.420*	(0.204)
Share inputs: Fruits	0.673**	(0.250)
Share inputs: Vegetables	0.250	(0.312)
Year 2009 (dummy)	0.267***	(0.071)
Observations	2067	

Standard errors in parentheses

Shocks and cluster dummies included, but not reported. Foodgrains is reference category.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table : Weighted summary statistics (2007)

	Treatment	Control	
		not matched	matched
Value of agr. production	27923.8	29115.5	25682.3
Variable inputs	13310.3	16774.2	13310.3
Area cultivated (acres)	3.91	3.53	3.91
Irrigated area (% of total)	0.15	0.20	0.15
Fertilizer (dummy)	0.97	0.92	0.97
Annual income, off-farm activities	25360.5	24529.2	25360.5
Housing quality index	0.46	0.51	0.46
Consumer durables index	0.15	0.21	0.15
Housing services index	0.50	0.49	0.50
Male household head	0.96	0.96	0.96
Age of hh head	41.3	41.8	41.3
Household head is literate	0.32	0.29	0.32
Any serious debts	0.67	0.51	0.67
Able to raise 1000 rupees in one week	0.57	0.49	0.57
Observations	506	612	612