

Does the Inverse Farm Size and Productivity Relationship Hold Among Larger Farms?

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Introduction and Motivation

- The Inverse relationship between farm size and productivity is an old puzzle (Chayanov 1926, Sen 1962)
- There has been a renewed interest in this relationship (IR) due to
 - Doubts about smallholder-led Ag. growth (Collier and Dercon, 2009)
 - Recent trends in farm size distribution in Africa (Jayne et al, 2016)
- Little known about this relationship among larger scale farmers
- Previous policy prescriptions relied on data on smallholders

This paper

- This Study:
 - Looks at the Relationship farm size and productivity beyond 5 ha
 - Looks at the role of labor market imperfections in driving the IR

Data

- Random sample of 503 farmers— mainly medium scale in 2014
- Revisit in 2015 for area planted in 2014
- 4 districts Bibiani, Offinso, Afram plains and Nkwanta



Farm size distributions

District	Region	<=5 ha	5-10 ha	10-20 ha	>20 ha	Total
Bibiani-Anhwiaso	Western	14	47	24	13	98
Nkwanta North	Volta	19	88	43	10	160
Afram Plains South	Eastern	12	49	35	19	115
Offinso North	Ashanti	12	53	46	19	130
Total (n)		57	237	148	61	503

Data Description continued-by Landholdings

	Full Sample (n=503)	Below 10 hectares (n=231)	From 10 to 20 hectares (n=179)	Above 20 hectares (n=93)
<i>Land Characteristics</i>	Means and Percentages			
Landholding(ha)	19.74	7.06	13.43	64.14
Area planted(ha)	11.09	6.41	10.73	23.64
<i>Input Use Characteristics</i>				
Used fertilizer (%)	53.11	47.39	57.87	58.24
Fertilizer(kg/ha)	48.53	43.28	57.80	43.68
Number of crops grown per holding	2.97	2.88	2.94	3.24
Number of fields per holding	3.35	3.18	3.31	3.84
Used weedicide (%)	86.17	83.91	88.76	86.81
Used Pesticide (%)	10.02	11.74	8.43	8.79
Used manure (%)	4.21	3.91	3.93	5.49
Used hired labor (%)	94.79	94.78	96.07	92.31
Hired labor days/ha	5.45	68.78	40.16	51.70
Used Family labor (%)	75.15	77.39	77.53	64.84
Family labor days/ha	18.52	19.31	21.02	11.62
Used communal labor (%)	17.03	12.61	21.91	18.68
Communal labor days/ha	5.31	4.65	5.80	6.00
Used Mechanization (%)	74.95	70.43	78.09	80.22

Estimation

- $\ln y_i = \beta_0 + \beta_1 \ln A_i + \mathbf{X}_i \boldsymbol{\Gamma} + \varepsilon_i$

y_i gross value per ha or net value per ha or TFP per ha

A_i area planted in hectares

\mathbf{X}_i vector of controls

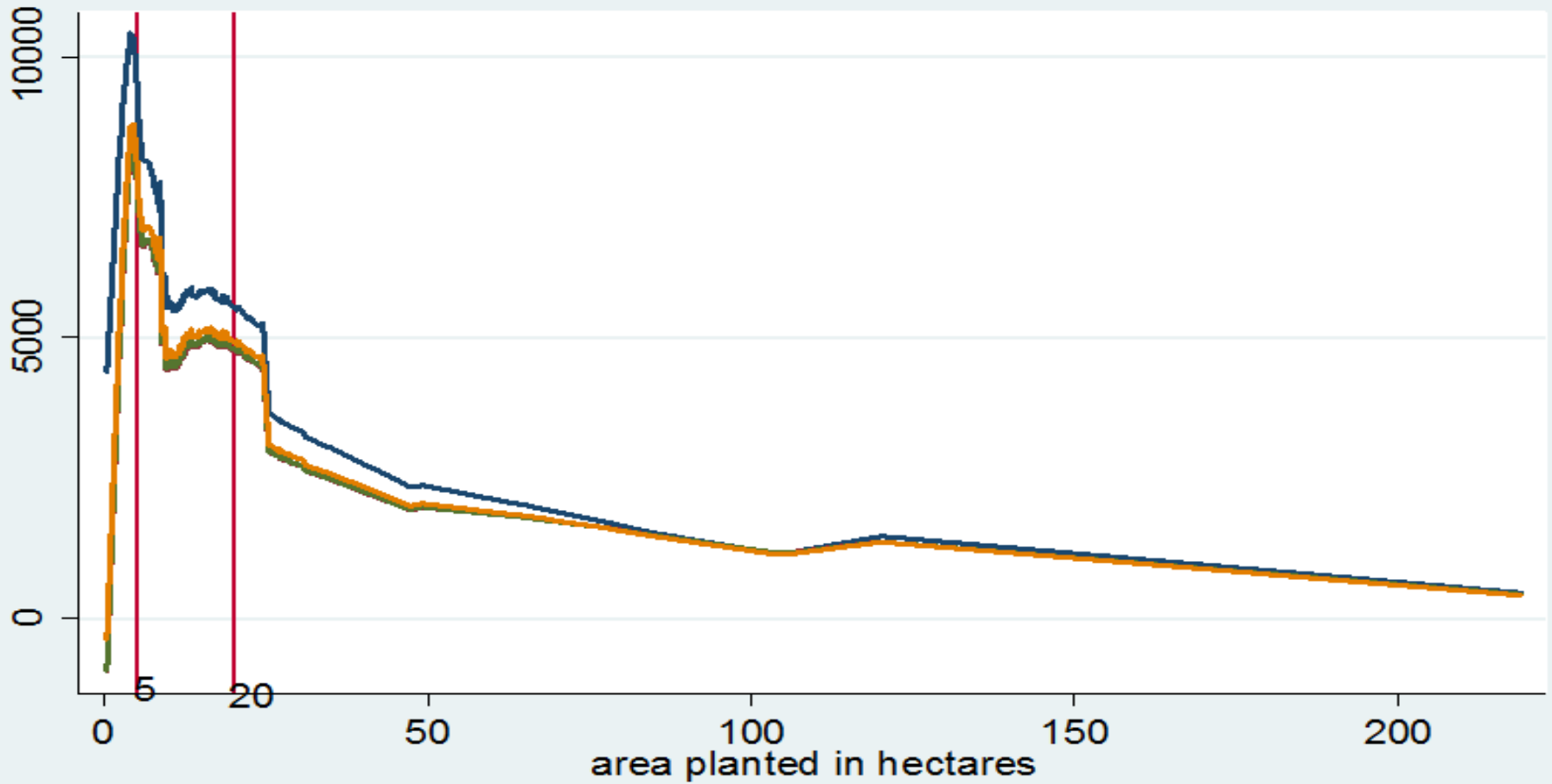
$\beta_1 < 0$ implies IR

$$TFP_i = \frac{Y_i}{K_i^{\alpha_{KL}^*} L_i^{\alpha_{LN_i}^*} N_i^{\alpha_N^*}}$$

Variable Definitions

- NVP1: Net value of production that values family, communal and child labor using median district wage of agricultural activities
- NVP2: does not include child labor
- NVP3: uses only hired labor
- NVP4 and NVP5 and correspond to NVP1 and NVP2 respectively but values family labor at shadow price
- Shadow Wages: $MPL_i = \hat{\beta} \left(\frac{\hat{Y}_i}{h_i} \right)$ where $\hat{\beta}$ is obtained from estimating the production. h is family labor days

Some Graphs



— Gross per hectare

— NVP2 per hectare

— NVP1 per hectare

— NVP3 per hectare

Results—OLS

Dependent variable:	Log (gross value output per hectare)	Log (net value output per hectare)		
	(1)	(NVP1)	(NVP2)	(NVP3)
Log (area planted)	-0.31*** (0.087)	-0.53*** (0.157)	-0.53*** (0.156)	-0.25* (0.138)
Crop dummies	Yes	Yes	Yes	Yes
Village dummies	Yes	Yes	Yes	Yes
Constant term	8.04*** (0.401)	8.17*** (0.696)	8.30*** (0.691)	7.99*** (0.637)
<i>N</i>	502	385	388	428
<i>Adjusted R</i> ²	0.2323	0.1704	0.1726	0.1910

Is hired Labor same as Family labor?

- $\ln N = \alpha + \beta L + \delta \ln w + \theta \frac{N^H}{N}$

N is total labor days

w is the price of labor

N^H is hired labor

$\frac{N^H}{N}$ is the fraction of hired labor

Test under the null hypothesis that $\theta = 0$

$\theta < 0 \Rightarrow$ hired labor is more efficient

Results: Family versus Hired Labor

Dependent variable:	Log (total labor demand)
Log (area planted in ha)	0.47 *** (0.072)
Log(average ag wage)	-0.14** (0.069)
Fraction of hired labor	0.17 (0.140)
Constant term	5.42*** (0.340)
Village Dummies	Yes
<i>N</i>	493
<i>Adjusted R</i> ²	0.2351

Results—Labor Market Imperfection

Dependent variable:	Log (Net value per hectare)	
	(NVP4)	(NVP5)
Log (area planted)	-0.437 ^{***} (0.152)	-0.442 ^{***} (0.150)
Village dummies	Yes	Yes
Crop dummies	Yes	Yes
Constant term	8.318 ^{***} (0.680)	8.331 ^{***} (0.672)
<i>N</i>	412	412
<i>Adjusted R</i> ²	0.1702	0.1642

Total Factor Productivity

(OLS)	
Log(area planted)	-0.341 ^{***} (0.11)
Crop dummies	Yes
Village dummies	Yes
Constant term	3.878 ^{***} (0.45)
N	502
R^2	0.337

Area Planted + Fallowed

	Gross value per hectare	Net value of production		
	(1)	NVP1	NVP2	NVP3
Log (area operated)	-0.406 ^{***} (0.083)	-0.536 ^{***} (0.139)	-0.551 ^{***} (0.138)	-0.079 (0.125)
Crop dummies	Yes	Yes	Yes	Yes
Village dummies	Yes	Yes	Yes	Yes
Constant term	7.927 ^{***} (0.421)	7.987 ^{***} (0.703)	8.158 ^{***} (0.698)	7.638 ^{***} (0.650)
<i>N</i>	502	385	388	428
<i>R</i> ²	0.361	0.354	0.353	0.350

Conclusions

- Area planted is inversely related to productivity
- No evidence of Labor market imperfection
- The existence of the IR should not lead to exclusive focus on smallholders with little or no attention to medium/large scale farmers