

AJAE Appendix: Testing Household-Specific Explanations for the Inverse Productivity Relationship

Juliano Assunção
Department of Economics
PUC-Rio

Luis H. B. Braido
Graduate School of Economics
Getulio Vargas Foundation

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Random-Effect Estimates

In the paper, we have focused on fixed-effect estimates. In this technical appendix, we show that the main results of table 3 are robust to the econometric specification with random effects. It is shown in table A1 that the coefficients of the logarithm of the plot cropped area (in a regression model with random effects) remains significantly negative with slightly larger absolute values. In the two regressions presented in that table, the Hausman's specification test favors the model with fixed effects.

Sharecropping and Fixed Rent

In the sample of plots with positive output, we find that 8,908 plots are cropped by owners and 1,796 plots are managed by tenants (under sharecropping and fixed rent). We decided to keep only the observations of owners in order to avoid incentive issues. To ensure that this decision is not affecting our results, we reproduced in table A2 the regressions from table 3 using the entire sample. The results remained the same, with only slight differences in magnitude.

Accounting for Plots with Zero Output

The log-linear specification adopted in the paper determines that some observations are lost due to the fact that the output per acre for some plots is zero. Plots with reported zero output are likely to be plots under rotation or temporarily abandoned. They should not be included in the analysis unless we impute their production level based on their observed characteristics. Table A3 presents the same exercises depicted in table 3, replacing the zeros with the expected output per acre obtained through a regression of the level of per acre output on the value of land, plot size, soil type dummies and village dummies. Our main results remained qualitatively identical.

Variance Decomposition of Main Variables

The empirical strategy of the paper is based on the use of a large number of fixed effects (268 or 2,633 depending on the specification) to account for nonobserved characteristics of the households.

The sample in table 3, on the other hand, is comprised by 8,906 observations. Table A4 presents ANOVA results for the main variables and shows that, despite the fixed effects, there is still reasonable variation to be captured by other variables.

Considering the logarithm of per acre output, panel (i) shows that only 23% of the variation is due to farmer fixed effects. For the case of farmer-season fixed effects, this amount is 57%. Thus, there is more than 40% of variation to be explained by other variables.

Panels (ii) and (iii) present the variance decomposition for plot size and total area cropped, respectively. Farmer fixed effects and farmer-season fixed effects account for less than 50% of the variation in all cases.

Gender Composition of Households

Table 4 shows that the inverse relationship holds true within households with a fixed number of adults. The idea of the test is to check whether the intrahousehold allocation of managerial resources is affecting the results, which it is not the case. Another dimension that could be considered in a similar vein is the gender composition of the households. However, table A5 shows that there is a strong and systematic relationship between the number of adults and gender composition. Thus, it is not possible to disentangle number of adults from gender composition. For instance, 61% of the households with only one adult are headed by a woman and 99% of the two-adult households are male-female couples.

Table A1. Household-Based Explanations – Random-Effect Estimates

Dependent Variable: Log Per Acre Output

	Random Effects I (household) (1)	Random Effects II (household & period) (2)
Log Plot Cropped Area	-0.171 ^{***} (0.024)	-0.172 ^{***} (0.024)
Log Total Cropped Area	0.038 ^{**} (0.016)	0.044 ^{***} (0.016)
Log Per Acre Land Value	0.358 ^{***} (0.046)	0.365 ^{**} (0.047)
Dummies for Irrigation and Soil Type	Yes	Yes
Constant and Dummies for the Main-Crop, Village, Year, and Season	Yes	Yes
p-value of the Hausman test (H_0 : difference in coefficients not systematic)	0.000	0.004
Number of Observations	8,906	8,906
Number of Groups	268	2633
R²	0.52	0.52

Note: Robust standard deviation (in parenthesis) account for the fact that farmers, rather than plots, are the primary sampling unit (* significant at 10%; ** significant at 5%; *** significant at 1%).

Table A2. Household-Based Explanations (with plots under sharecropping and fixed rent)*OLS*

Dependent Variable: Log Per Acre Output

	Without Soil Quality	With Soil Quality	Total Area	Fixed Effects I (household)	Fixed Effects II (household & period)
	(1)	(2)	(3)	(4)	(5)
Log Plot Cropped Area	-0.328*** (0.026)	-0.184*** (0.0206)	-0.200*** (0.021)	-0.189*** (0.022)	-0.183*** (0.024)
Log Total Cropped Area			0.046*** (0.017)	-0.005 (0.017)	
Log Per Acre Land Value		0.402*** (0.042)	0.389*** (0.042)	0.359*** (0.044)	0.407*** (0.059)
Dummies for Irrigation and Soil Type	No	Yes	Yes	Yes	Yes
Constant and Dummies for the Main-Crop, Village, Year, and Season	Yes	Yes	Yes	Village Dropped	Village, Year, and Season Dropped
Number of Observations	10,704	10,702	10,702	10,702	10,702
Number of Groups				275	2,733
R²	0.38	0.52	0.52	0.57	0.69

Note: Robust standard deviation (in parenthesis) account for the fact that farmers, rather than plots, are the primary sampling unit (* significant at 10%; ** significant at 5%; *** significant at 1%). Fixed effects I refer to 275 household dummies; while fixed effects II refer to 2,733 dummy variables generated through the iteration of the household and period codes (household-village, year, and season).

Table A3. Household-Based Explanations (with inputted values for plots with zero output)*OLS*

Dependent Variable: Log Per Acre Output

	Without Soil Quality	With Soil Quality	Total Area	Fixed Effects I (household)	Fixed Effects II (household & period)
	(1)	(2)	(3)	(4)	(5)
Log Plot Cropped Area	-0.309*** (0.028)	-0.182*** (0.021)	-0.200*** (0.022)	-0.192*** (0.024)	-0.188*** (0.025)
Log Total Cropped Area			0.049*** (0.016)	0.009 (0.017)	
Log Per Acre Land Value		0.407*** (0.048)	0.390*** (0.044)	0.366*** (0.048)	0.393*** (0.066)
Dummies for Irrigation and Soil Type	No	Yes	Yes	Yes	Yes
Constant and Dummies for the Main-Crop, Village, Year, and Season	Yes	Yes	Yes	Village Dropped	Village, Year, and Season Dropped
Number of Observations	9,492	9,490	9,490	9,490	9,490
Number of Groups				271	2,688
R²	0.35	0.49	0.49	0.53	0.67

Note: Robust standard deviation (in parenthesis) account for the fact that farmers, rather than plots, are the primary sampling unit (* significant at 10%; ** significant at 5%; *** significant at 1%). Fixed effects I refer to 271 household dummies; while fixed effects II refer to 2,688 dummy variables generated through the iteration of the household and period codes (household-village, year, and season).

Table A4. Analysis of Variance

Source	Partial sum of Squares (%)	Degrees of Freedom	Prob. > F
<i>(i) Log Per Acre Output</i>			
Model	6,068.33 (39%)	303	0.000
Farmer Fixed Effects	3,509.11 (23%)	267	0.000
Year and Season Dummies	1,582.61 (10%)	36	0.000
Residual	9,507.52 (61%)	8,604	
Total	15,575.85	8,907	

Model	8,816.20 (57%)	2,632	0.000
Farmer-Season Fixed Effects	8,816.20 (57%)	2,632	0.000
Residual	6,759.64 (43%)	6,275	
Total	15,575.85	8,907	
<i>(ii) Log Plot Cropped Area</i>			
Model	2,472.33 (31%)	303	0.000
Farmer Fixed Effects	1,884.13 (24%)	267	0.000
Year and Season Dummies	142.89 (2%)	36	0.000
Residual	5,436.82 (69%)	8,604	
Total	7,909.16	8,907	

Model	3,768.37 (48%)	2,632	0.000
Farmer-Season Fixed Effects	3,768.37 (48%)	2,632	0.000
Residual	4,140.79 (52%)	6,275	
Total	7,909.16	8,907	
<i>(iii) Log Total Cropped Area</i>			
Model	2,095.71 (60%)	303	0.000
Farmer Fixed Effects	1,390.17 (40%)	267	0.000
Year and Season Dummies	581.27 (17%)	36	0.000
Residual	1,385.62 (40%)	2,329	
Total	3,481.34	2,632	

Table A5. Adults and Male Adults

Number of adults	Distribution According to the Number of Male Adults						Total
	0	1	2	3	4	5	
1	61.4%	38.6%	--	--	--	--	100%
2	0.6	98.7%	0.7%	--	--	--	100%
3	0.0%	54.9%	45.1%	0.0%	--	--	100%
4	0.0%	6.7%	83.8%	9.5%	0.0%	--	100%
5	0.0%	2.6%	17.7%	63.6%	16.1%	0.0%	100%
6	0.0%	3.1%	3.1%	67.1%	26.7%	0.0%	100%
7	0.0%	5.0%	0.0%	24.2%	70.9%	0.0%	100%
8	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100%
Total	3.57%	53.9%	26.77%	11.05%	4.54%	0.18%	100%