Faculdade de Economia,
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Universidade de São Paulo

Texto para Discussão

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Três Ensaios sobre Desenvolvimento Agrícola na América Central: Uma Abordagem Semiparametrica Usando Dados de Painel

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A série TEXTO PARA DISCUSSÃO tem como objetivo divulgar: i) resultados de trabalhos em desenvolvimento na FEA-RP/USP; ii) trabalhos de pesquisadores de outras instituições considerados de relevância dadas as linhas de pesquisa da instituição. Veja o site da Comissão de Pesquisa em **www.cpq.fearp.usp.br**. Informações: e-mail: cpq@fearp.usp.br

Three Essays in Agricultural Development in Central America: Semiparametric Analyses Using Panel Data

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Outline

- Overview
  1. Essay 1: Semiparametric Regression and Matching Estimators: Evaluating the Impact of Natural Resource Management Program on Farm Output in Honduras
  2. Essay 2: Agricultural Productivity and Off-Farm Labor Decisions by Farm Household Heads and their Spouses in Nicaragua: A Semiparametric Analysis using Panel Data
  3. Essay 3: Land Use and Agricultural Production in Nicaragua: A Fixed Effects Semiparametric Analysis
- Concluding Remarks

The Complex Rural Central American Sector

- Central American countries have been affected by unsuccessful economic policies, regional conflicts, civil wars, authoritarian governments, failed land reforms, and natural disasters (Panayotou, 2001)
- The majority of Central American poor people are small farmers, women, landless workers and indigenous groups who are located in low-productivity and degraded areas (IFAD, 2009)
- These populations depend on agricultural and non-agricultural employment as the main source of their income (IFAD, 2009)

Some Numbers

Table: Economic Indicators for Selected Countries, 2003-2005.

Country	GDP/ Capita U.S. $	(%) Rural Pop	Employment Agri (% of Tot)	Agri, Value Added (% GDP)	Pop Living Below U.S. $2 a day (%)	Rural Pop Living Below U.S. $1.75 a day (%)
Chile	7,073	12	13	9	6	13
Peru	7,088	26	9	10	27	70
Argentina	4,728	10	1	11	17	-
Costa Rica	4,627	38	15	9	10	20
Brazil	4,271	16	21	6	21	41
Bolivia	3,989	36	5	15	37	80
El Salvador	2,467	40	19	9	41	57
Sri Lanka	1,196	85	34	19	42	-
Honduras	1,151	54	39	13	42	80
Nicaragua	954	41	31	18	41	71
Kenya	547	79	19	16	58	-
Ghana	485	52	55	36	79	-

Source: United Nation Development Programme, Economic Commission for Latin America and the Caribbean and World Bank.

Future Challenges

- Poverty reduction is one of the major current challenges to be faced in the region (IFAD, 2009)
- Recognizing this major challenge, the international community has come around to the old idea, formalized by Johnston and Mellor (1961), that agricultural productivity growth is an essential component of any development strategy (World Bank, 2008)
- Anti-poverty strategies that promote development of the rural sector in a sustainable way is imperative for meeting the Millennium Development Goals, addressing the world food crisis, and preserving the environment (United Nations, 2008)

ESSAY 1

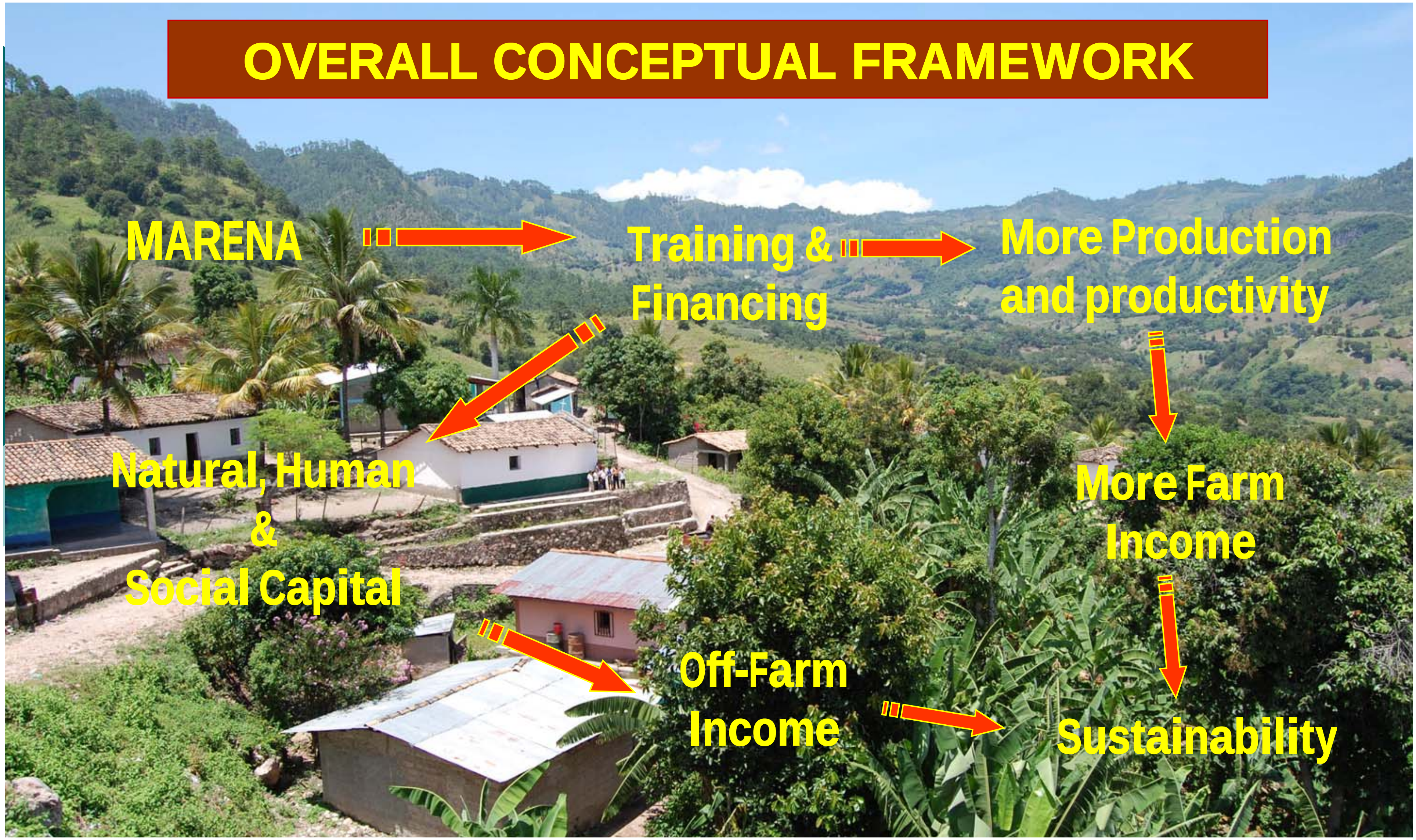
Semiparametric Regression and Matching Estimators: Evaluating the Impact of Natural Resource Management Program on Farm Output in Honduras

Introduction

- Honduran rural poverty is largely a consequence of unsustainable land use leading to environmental degradation, productivity losses and food insecurity (GEF-IFAD Report, 2002)
- A key strategy to increase income is the provision of agricultural assistance along with infrastructure development, market access, provision of inputs, and training (Anderson & Feder, 2007)
- Working HYPOTHESIS: if farmers receive private benefits from adoptive practices promoted by projects (e.g., soil conservation, farm diversification, training, financing) then such adoption is likely to be sustainable and to generate positive externalities

HONDURAS

Many farmers try to eke a leaving cultivating steep slopes, a practice associated with deforestation, soil erosion, and declining water quantity and quality, among other severe problems, all of which **feeds back to lower farm productivity and worsening poverty rates**.



The **major activities** undertaken with **beneficiaries** include **training** in **various aspects** of business management and **sustainable** farming practices, and the provision of funds to co-finance investment activities through local rural savings associations.

Recent Related Papers Analyzing Project Interventions in Developing Countries

1rst Author	Year	Country	Intervention/Project: Indicator
Cerdan-Infante	2008	Argentina	Extension: Grapes Yield & Quality
Lopez	2008	Uruguay	Livestock: Management, Productivity and Specialization
Godtland	2003	Peru	Extension: Productivity Potatoes
Nakasone	2008	Peru	Land Titling: Labor Allocation
Sadoulet	2001	Mexico	PROCAMPO: Cash Transfers on Income
Skoufias	2005	Mexico	PROGRESA: Poverty Alleviation-multiple
Rodriguez	2007	Philippines	Ag. Dev. Project: Farm Income
Feder	2006	Indonesia	Extension: Rice Yields & Pesticide Use
Praneetvataku,	2006	Thailand	Extension: Rice Yields & Pesticide Use
Dillon	2008	Mali	Irrigation: Value of Ag. Production
Essama-Nssah	2008	Rwanda	Privatization: Inc/Expend. Tea Farmers

Objectives

- To evaluate the farm-level impact of the Natural Resource Management Program MARENA (*Ma*nejo de *Re*cursos *Na*turales en Cuencas Prioritarias)
- The objective was to finance several activities to enhance agricultural production and the sustainable management of natural resources.

Contribution

- Evaluation of the impact of an agricultural development intervention in Central America using recent methodological approaches
- Comparison of a range of methods to calculate PSM and Average Treatment Effects including semiparametric options

Treatment Evaluation Method

- The Average Treatment Effect on the Treated

$$\begin{aligned} ATET &= E[Y_i^T - Y_i^C | X, D_i = 1] \\ &= E[Y_i^T | X, D_i = 1] - E[Y_i^C | X, D_i = 1] \end{aligned} \tag{1}$$

- Note that both outcomes are not observed at the same time and, as a result, the counterfactual situation $E[Y^C | X, D = 1]$ needs to be constructed

Propensity Score Matching (PSM)

- PSM method yields a “score" equal to the probability of receiving treatment (Probit or Logit Models), considering both treated and non-treated groups, given a set of predetermined covariates


Propensity Score Matching (PSM)

- Several matching techniques have become available, but
  - nearest-neighbor
  - radius
  - kernel matching
  - and stratification

  have been the ones most commonly employed
- The use of propensity score matching does not get rid of bias completely, but provides a good approximation (Imbens & Woodridge, 2008)

The Difference-in-Differences Estimator

- Another source of bias can arise from unobserved characteristics among individuals. Heckman et al., (1997) propose to estimate the ATET by

$$DID = E\{E(B^{2008} - B^{2004}|X, D = 1) - E(C^{2008} - C^{2004}|X, D = 0)|D = 1\} \quad (2)$$

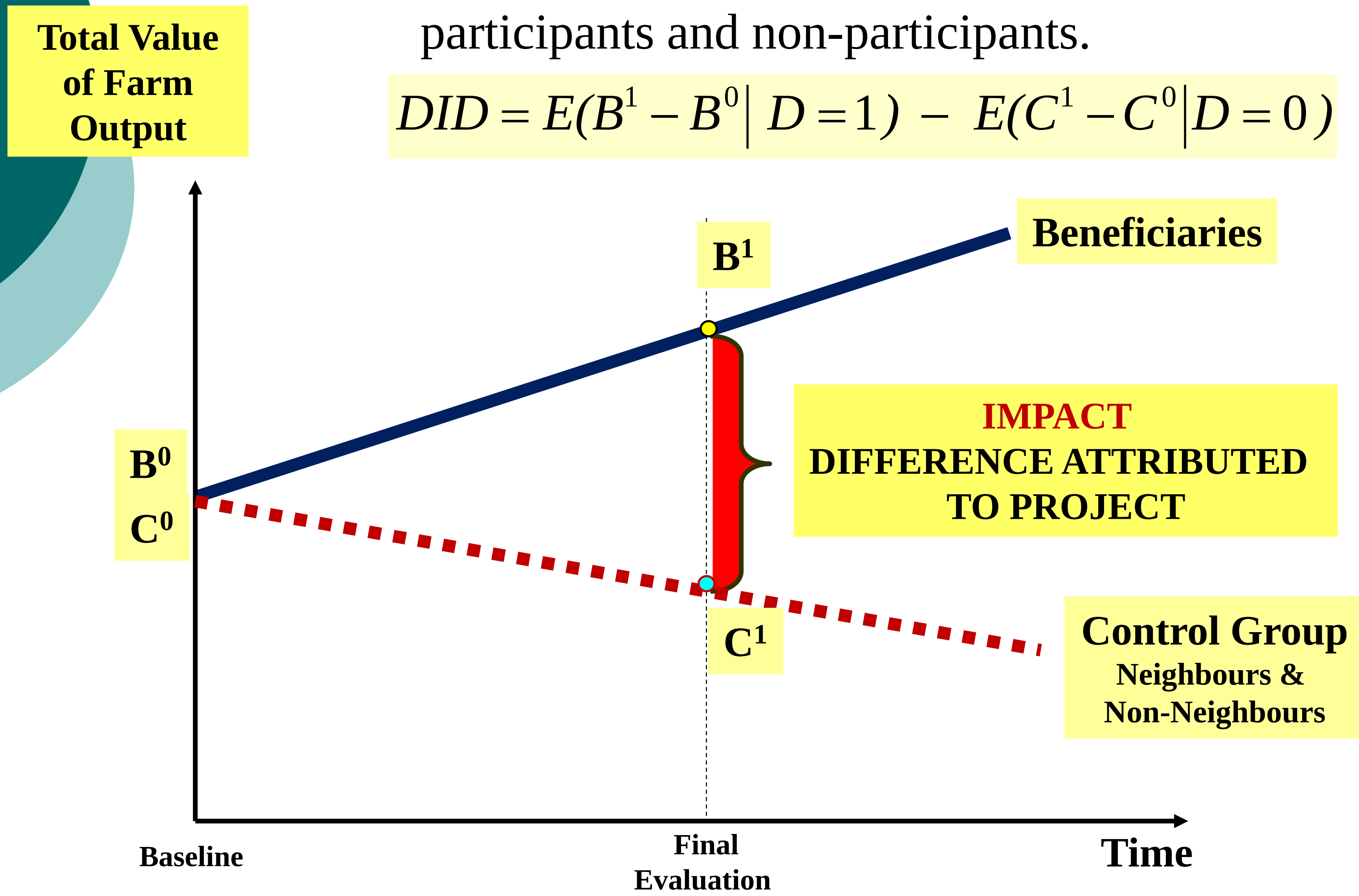
Or, alternatively (Angrist & Pischke, 2009)

$$Y_{i,t} - Y_{i,t-1} = (T_t - T_{t-1})\lambda + (BT_{i,t} - BT_{i,t-1})\gamma + \varepsilon_{i,t} - \varepsilon_{i,t-1} \quad (3)$$

METHODOLOGY

The Difference-in-Differences Estimator (DID): To control for some unobserved factors (e.g. managerial skills) between participants and non-participants.

$$DID = E(B^1 - B^0 \mid D=1) - E(C^1 - C^0 \mid D=0)$$



A Semiparametric Approach to PSM

- A misspecification of the propensity score function (Logit or Probit) can have a significant impact on the magnitude of the scores and thus on the associated estimation of the impact (Li & Racine, 2004)
- The Klein and Spady (1993) estimator

$$\hat{\theta}_{KS} = argmax \sum_{i=1}^{n} \left[D_i ln \hat{F}(X_i' \theta) + (1 - D_i) ln(1 - \hat{F}(X_i' \theta) \right] \tag{4}$$

$$\hat{F}(X_i' \theta) = \frac{\sum_{j=1}^{n} D_j K \left[(X_i \theta - X_j \theta) / b_n \right]}{\sum_{j=1}^{n} K \left[(X_i \theta - X_j \theta) / b_n \right]} \tag{5}$$

Steps

Step 1: Estimate a Logit model and a semiparametric model to calculate the probability (propensity score) that the farmer is a beneficiary of MARENA

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Step 2: Using both propensity score vectors from step (1) we perform the matching based on different algorithms and calculate the ATET

Steps

Step 1: Estimate a Logit model and a semiparametric model to calculate the probability (propensity score) that the farmer is a beneficiary of MARENA
Step 2: Using both propensity score vectors from step (1) we perform the matching based on different algorithms and calculate the ATET
Step 3: To capture possible spill-over effects a regression model is estimated using propensity scores as weights

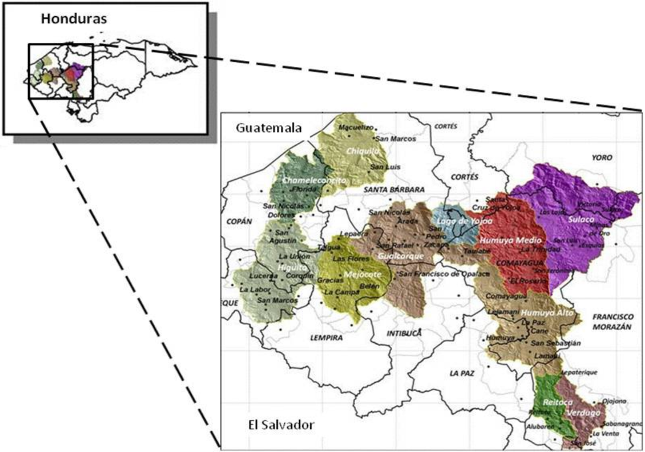
Data

- A two-year panel covering 366 households
  - 109 ==> Beneficiaries
  - 257 ==> Control Group
- Control group:
  - 143 households are located within the targeted area of the MARENA program (neighbors)
  - 114 households are located outside (non-neighbors)
- The farmers were interviewed during the 2003-04 agricultural season and again in 2007-08

MARENA: SAMPLE SELECTION

- **Beneficiaries:**
  - The population conformed by all producers in MARENA's data base that had projects approved or under implementation in 2004. A stratified random sample was selected where the strata where the sub-watersheds. Beneficiaries were chosen in proportion to the number of beneficiaries per sub-watershed.
- **Control Group:**
  - Neighbors: The population is producers that live within MARENA's sub-watersheds but that were not beneficiaries. Communities were selected randomly by watershed and three elevation categories and a full list of households in each community was drawn. The list was the basis to random select the Neighbors in proportion to the total number of households per sub-watershed distributed according to 3 elevation groups.
  - Non-Neighbors: The population for Non-Neighbors consists of producers that live in areas of MARENA municipalities that are outside the sub-watersheds included in the Program. The sampling follows a similar pattern as the one for Neighbors.

Area of Influence of the MARENA Program



Results

Table 4.1 Logit and K&P results for participation in MARENA using Baseline Data (2004)

Variables	LOGIT[A]		Semiparametric (Klein and Spady, 1993) [A]	
	Coeff	dy/dx	Coeff	dy/dx
AGLAND	-0.375	-0.0676	-0.380	-0.0400
	(0.094)***		(0.0614)***	
CAFFECO	4.035	0.7141	4.604	0.4853
	(1.034)***		(0.732) ***	
NUMBER	0.038	0.0069	0.042	0.0044
	(0.050)		(0.0075) ***	
ALTITUD	-0.474	-0.0855	-0.607	-0.0640
	(0.281)*		(0.097) ***	
AGE	-0.013	-0.0023	-0.036	-0.0038
	(0.010)		(0.0057) ***	
EDUC	-0.035	-0.0063	-0.089	-0.0094
	(0.050)		(0.013) ***	
ORGA	2.296	0.4392	3.423	0.3609
	(0.295)***		(0.535) ***	
ASSIST	0.673	0.1293	0.524	0.0553
	(0.290)**		(0.0864) ***	
DIVER	0.523	0.0951	0.721	0.0760
	(0.299)*		(0.1157) ***	
CONSTANT	-1.056	-	-	-
	(0.624)*			
N	366		366	
LR chi2(9)	78.95***			
Pseudo R2	0.242			
Log likelihood	-169.947		-158.307	
Correctly classified	79%			
Wald chi2(9)			46.19***	

* p<0.10; ** p<0.05; *** p<0.01

[A] Standard Errors in parenthesis

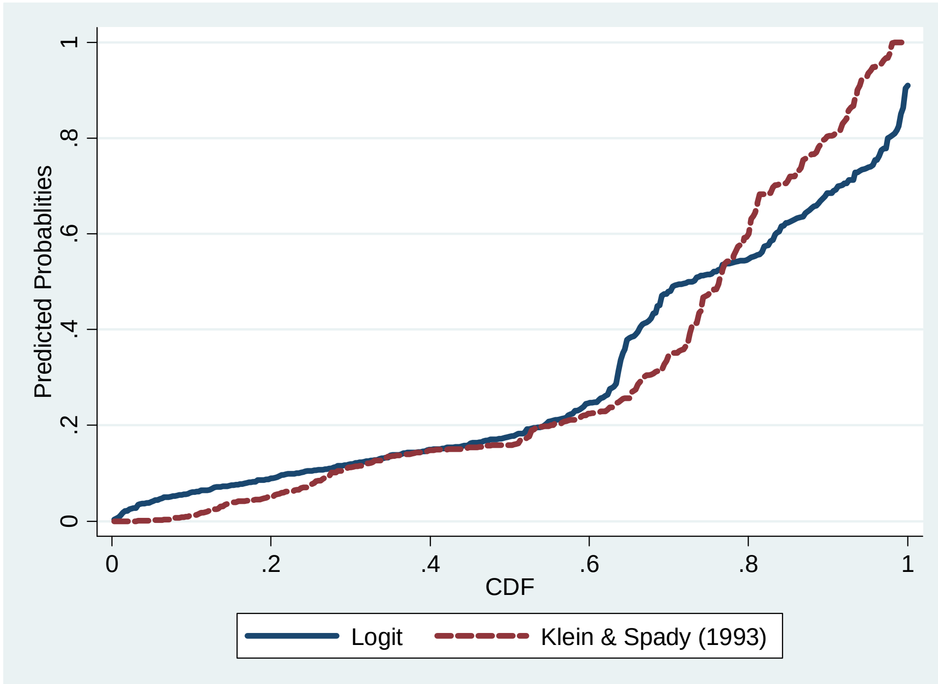


Figure 4.1 Predicted Probabilities between Logit and Klein and Spady (1993) models.

Table 4.2 Impact of MARENA on Total Value of Agricultural Output in Lempiras for Different Estimators[A]

Outcome Variable $TVAO = TVAO_t - TVAO_{t-1}$	Treated	Control	Impact (ATET)	Standard Error
Naïve estimator				
Full Sample (Unmatched)	109	257	13,886**	(7,813)
Matching Methods				
1)*Nearest Neighbor Matching*				
Logit	109	62	15,305	(13,778)
Klein and Spady	109	55	18,463	(16,403)
2)*Radius Matching, r=.30*				
Logit	109	228	16,989**	(7,924)
Klein and Spady	109	217	20,674***	(8,113)
3)*Radius Matching, r=.10*				
Logit	107	228	15,159**	(7,683)
Klein and Spady	101	217	12,417**	(8,175)
4)*Radius Matching, r=.05*				
Logit	105	228	16,426**	(7,930)
Klein and Spady	100	217	12,223**	(8,145)
5)*Radius Matching, r=.01*				
Logit	98	202	15,794*	(8,616)
Klein and Spady	79	200	12,843*	(9,797)
6)*Stratification*				
Logit	109	228	18,894**	(9,323)[c]
Klein and Spady	109	215	19,122**	(9,773)[c]
7)*Heckman Kernel*[B]				
Logit	109	228	20,654**	(9,268)[c]
Klein and Spady	109	217	19,651**	(10,145)[c]

* p<0.10; ** p<0.05; *** p<0.01.

[A] The regions of common support for the Logit and K&S are, respectively, [0.169, 0.905] and [0.111, 0.991], and the balancing property is satisfied following the test implemented by Becker and Ichino (2002).

[B] The optimal bandwidth was calculated based on the cross-validation (CV) method.

[C] Bootstrap standard errors using 300 replications of the sample.

We would like to thank Michael Cohen for making the CV MATLAB code available.

Table 4.3 DID Fixed Effects Results for Total Value of Farm Output as Dependent Variable[A]

Variables	No PS Weight		PS (Logit) Weighted		PS (Klein and Spady) Weighted	
	Coef	SE[B]	Coef	SE[B]	Coef	SE[B]
BENEF	14,081.23*	(7,137.42)	18,736.08*	(10,650.78)	23,346.57**	(10,871.49)
NEIGHBOR	512.21	(8,820.69)	1,756.40	(10,444.92)	9,124.51	(10,183.70)
YEAR	-558.53	(7,207.20)	-4,094.13	(8,335.793)	-8,828.08	(8,176.51)
AGLAND	6,898.55***	(1,952.02)	7,632.51**	(2,971.846)	1,119.346	(1,212.57)
EXPEND	.1047	(0.1328)	0.0577	(0.1613)	0.3719**	(0.1650)
LABOR	.3635*	(0.2094)	0.4494	(0.3121)	0.3740**	(0.2206)
ORGA	3,543.53	(8,532.14)	-1,525.40	(10,764.12)	-1,919.44	(7,307.11)
TITLE	2,174.05	(6,012.24)	7,135.99	(7,601.742)	6,861.09	(8152.71)
CONSTANT	7,137.42	(9,721.07)	9,291.31	(17,610.36)	10,455.44	(11971.15)
Farm Fixed Effects	yes		yes		yes	
N	732		732		732	
F(8, 358)	6.02***		3.91***		2.20**	
R-squared	0.77		0.91		0.75	
Adj R-squared	0.54		0.82		0.49	

* p<0.10; ** p<0.05; *** p<0.01.

[A] The least-squares with dummy-variable (LSDV) estimator is used (Cameron and Trivedi, 2009).

[B] Robust Standard Errors in parenthesis.

ESSAY 2

Agricultural Productivity and Off-Farm Labor Decisions by Farm Household Heads and Their Spouses in Nicaragua: A Semiparametric Analysis Using Panel Data

Introduction

- There is growing evidence that rural non-farm income is a very important resource for poor households in developing countries (World Bank, 2008).
- The lack of job opportunities in rural areas forces poor farmers to sell their labor in farm and/or nonfarm markets or to migrate in order to meet basic household needs.
- Moreover, off-farm income can also be an important source of cash to purchase inputs and make on-farm investments which can lead to improved yields, higher labor productivity and additional income (McCarthy & Sun, 2009).

Some Numbers

Table: Rural Household's Income share (%), 2001.

Country	Agricultural Income self-employed	Agricultural Income wage	Nonagricultural Income self-employed	Nonagricultural Income wage	Transfers
Ethiopia	74	3	3	5	16
Ghana	55	2	15	22	5
Bangladesh	15	13	21	22	29
Pakistan	43	6	24	12	17
Indonesia	17	9	34	23	16
Vietnam	35	4	8	49	4
Ecuador	29	18	25	24	4
El Salvador	17	9	32	23	18
Guatemala	25	22	21	14	19
Nicaragua	22	21	31	17	10

Source: World Bank Report (2008).

The Importance of Women

- Empirical evidence also shows that in some traditional societies in which women were not allowed to work are starting to liberalize this restriction (World Bank, 2008).
- The participation of women in labor markets has enhanced their bargaining power and status, while also improving the overal household's welfare (Newman & Canagarah, 2000).
- When women, as head of households, get the same level of education, experience and farm inputs as men, their agricultural yields are 22% higher than those their male counterparts. Furthermore, women's education and their status are key factors to reduce child malnutrition and poverty (IFPRI, 2000).

The Debate

- There is a consensus that income from nonfarm activities has become increasingly important in the livelihoods of poor households in developing countries
- However, in very poor countries such as Nicaragua, development policies aimed at increasing agricultural productivity and empowering women, can be an important instrument in poverty alleviation

Objectives

- To investigate the participation of farm household heads and their spouses on off-farm activities in Nicaragua using a balanced panel data set for the years 1998, 2001 and 2005
- Contribution
  - The analyses of the impact of the marginal productivity of farm labor (shadow wage) on off-farm labor supply for heads and spouses
  - The empirical strategy uses panel data along with a semi-parametric fixed effects approach while correcting for selectivity bias (reservation wage)

Theoretical Framework

- We follow the classical agricultural household, where a household problem composed of one head (H) and one spouse (S), maximizes utility (Strauss, 1986) and (Jacoby, 1994)
- From the FOC of the utility model, the off-farm labor supply functions for the head (HD) and Spouse (SP) of interest here are:

$$M_H^* = M_H(W_{H,S}^*, W_{H,S}^*, W_{H,S}^M, W_{H,S}^M, I^*; Q) \tag{1}$$

and

$$M_S^* = M_S(W_{H,S}^*, W_{H,S}^*, W_{H,S}^M, W_{H,S}^M, I^*; Q) \tag{2}$$

Data

- The Living Standard Measurement Survey (LSMS), a nationwide household survey, carried out by the Nicaraguan Statistical Service and the World Bank during 1998, 2001 and 2005
  - Balanced Panel data
  - Farm land (titled or untitled owned, borrowed and/or rented) was not zero for at least two years of the survey
  - Household with a head and a spouse for all three years of the survey
- Balanced panel containing 559 observations

Econometric Strategy

- Kyriazidou (1997) developed a panel data estimator that corrects for selectivity bias and also controls for other sources of bias that arise from time-invariant unobserved individual characteristics

$$y_{it}^{*} = x_{it}\beta + \alpha_i + \varepsilon_{it} \tag{3}$$

$$d_{it} = w_{it}\gamma + \eta_i + \mu_{it} \tag{4}$$

d_{it} if $d_{it}^{*} \geq 0$, 0 otherwise

$$y_{it}^{*} = [x_{it}\beta + \alpha_i + \varepsilon_{it}]d_{it} \tag{5}$$

Kryrizidou (1997) Estimator

$$\hat{\beta} = \left[\sum_{i=1}^{n} \hat{\phi}_{in} (x_{it} - x_{is})' (x_{it} - x_{is}) d_{it} d_{is} \right]^{-1} \left[\sum_{i=1}^{n} \hat{\phi}_{in} (x_{it} - x_{is})' (x_{it} - x_{is}) d_{it} d_{is} \right] \tag{6}$$

where $\hat{\phi}_{in} = \frac{1}{b_n} K \left(\frac{(w_{i,t} - w_{i,s}) \hat{\gamma}_n}{b_n} \right)$ and where $\hat{\phi}_{in}$ is a kernel weight

1. Get estimates for γ by using a conditional fixed effects logit model (Askildsen et al., 2003; Charlier et al., 2001)
2. The estimates $\hat{\gamma}$ are then used to construct kernel weights and β is estimated by the traditional weighted ordinary least squares (WLS) method

Shadow Wages and Shadow Income

- From the estimates of the fixed effects production function, separate shadow wages the head and the spouse, and shadow income for the household are calculated (Jacoby, 1993):
  - Agricultural Shadow Wage:

$$\hat{W}_{HD} = \beta_{HRon_{HD}} \left(\frac{\widehat{TVFO}}{HRon_{HD}} \right) \tag{7}$$

$$\hat{W}_{SP} = \beta_{HRon_{SP}} \left(\frac{\widehat{TVFO}}{HRon_{SP}} \right) \tag{8}$$

  - Agricultural Shadow Income:

$$\begin{aligned} \hat{I} &= \widehat{TVFO} - \hat{W}_{HD}(HRonHD) - \hat{W}_{SP}(HRonSP) \\ &= \beta_{inputs}(INPUTS) - \beta_{hired}(HIRED) \end{aligned} \tag{9}$$

Econometric Strategy: Steps

Step 1: Estimate a production function to calculate the shadow wages for heads and spouses, and shadow income

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Econometric Strategy: Steps

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Step 3: Estimate the selection equations
Step 4: Calculate the Kernel Weights
Step 5: Estimate the participation equations

Results

Table 2.1 Agricultural Production Function Estimates

Dependent Variable: LNTVFO	FIXED EFFECTS		POOLED OLS	
	Coeff	SE†	Coeff	SE†
Farm Characteristics				
LN LAND	0.2734***	(0.105)	0.220***	(0.056)
LN INPUTS	0.4912***	(0.041)	0.549***	(0.034)
LN HIRED	0.2548***	(0.074)	0.335***	(0.056)
LN HRonHD	0.2563***	(0.050)	0.246***	(0.036)
LN HRonSP	0.1027	(0.068)	0.106**	(0.051)
CREDIT	0.2282	(0.166)	0.209	(0.134)
TITLE	0.8592***	(0.169)	0.686***	(0.136)
TRAINING	0.4600**	(0.219)	0.375**	(0.180)
RENTLAND	0.7046***	(0.176)	0.509***	(0.144)
Young and Adult Children Working On-Farm				
Son				
SonFARM 5 - 15	0.0687	(0.161)	0.152	(0.132)
SonFARM 15 - 22	0.4731***	(0.158)	0.411***	(0.123)
SonFARM 22 - 31	-0.0934	(0.234)	-0.114	(0.183)
Daughter				
DonFARM 5 - 15	-0.5229**	(0.227)	-0.360*	(0.209)
DonFARM 15 - 22	-0.1407	(0.270)	0.252	(0.273)
DonFARM 22 - 31	-0.2160	(0.428)	-0.345	(0.378)
Geographic Characteristics				
PACIFICO	-	-	0.467	(0.473)
CENTRAL	-	-	0.729	(0.471)
ATLANTICO	-	-	1.430***	(0.480)
DUMYEAR2	0.0063	(0.154)	0.187	(0.150)
DUMYEAR3	0.5584***	(0.161)	0.744***	(0.155)
CONSTANT	0.3476***	(0.253)	-0.515	(0.482)
Hausman chi2(17)	24.03*			
N	1677		1677	
F	36.86***		109.64***	
R^2	0.4222		0.4179	

* p<0.10; ** p<0.05; ***p<0.01.
†Robust standard errors

Table 2.2 Head and Spouse Participation Equations: Conditional Fixed Effects Logit and Pooled Logit

Dep Var: 1 if work off-farm	Head					Spouse				
	Fixed Effects			Pooled		Fixed Effects			Pooled	
	Coeff	SE†	ME£	Coeff	SE†	Coeff	SE†	ME£	Coeff	SE†
Head Characteristics										
EDUCHD	0.1537	(0.212)	.00313	0.286***	(0.070)	-0.1910	(0.194)	-.00015	-0.0063	(0.052)
AGEHD	0.1613**	(0.080)	.00328	0.139***	(0.052)	-0.0207	(0.033)	-.000016	-0.0314***	(0.011)
AGEHD2	-0.0024**	(0.001)	-.00005	-0.0017***	(0.0006)	-	-		-	-
Spouse Characteristics										
EDUCSP	0.3301*	(0.208)	.00672	0.1028*	(0.060)	0.6187***	(0.227)	.00050	0.2514***	(0.055)
AGESP	-0.0044	(0.030)	-.00009	-0.0065	(0.010)	0.1922	(0.134)	.00015	0.1460***	(0.035)
AGESP2	-	-		-	-	-0.0015	(0.001)	-1.2e-06	-0.0013***	(0.0004)
Farm Characteristics										
TITLE	-0.3480	(0.437)	-.00757	-0.78923***	(0.229)	-0.0139	(0.408)	-.000011	-0.1188	(0.169)
LAND	-0.0305	(0.027)	-.000622	-0.0061	(0.004)	0.0068	(0.008)	5.58e-06	-0.0040	(0.004)
LIVT_ASSET	0.00021*	(0.0001)	4.3e-06	-0.00001	(0.0001)	-0.00003	(0.0001)	-2.3e-08	0.00002**	(0.0004)
TRAINING	0.8689	(0.783)	.0128461	0.1414	(0.349)	0.1923	(0.605)	.00014	0.2068	(0.252)
ORGANIZATION	-0.2465	(0.631)	-.00549	-0.0911	(0.339)	0.8244*	(0.456)	.00051	0.5305**	(0.223)
EFFICIENCY	-0.0625**	(0.024)	-.001273	-0.0466***	(0.016)	-0.0333*	(0.015)	-.00002	-0.0116**	(0.005)
Household Characteristics										
HHSIZE	0.286**	(0.130)	.00582	0.1069***	(0.041)	0.0965	(0.089)	.000078	-0.0976**	(0.041)
CHILD=< 5	-0.3266	(0.458)	-.00650	-0.3912**	(0.210)	0.0340	(0.373)	.000027	0.0251	(0.184)
REMITTANCES	-0.0061	(0.004)	-.00012	-0.004	(0.002)	-0.0009	(0.0008)	-7.4e-07	-0.0006	(0.009)
Young and Adult Children Working										
Son										
SonFARM 5 - 15	-1.4774**	(0.600)	-.05409	-1.0699***	(0.315)	-0.0542	(0.430)	-.00004	-0.0952	(0.213)
SonFARM 15 - 22	-1.3378**	(0.611)	-.0430	-0.7323***	(0.272)	0.0205	(0.434)	.00001	-0.3905*	(0.205)
SonFARM 22 - 31	-2.5977**	(1.105)	-.17458	-1.2399**	(0.550)	0.4418	(0.609)	.000301	-0.0037	(0.280)
SoffFARM 5 - 15	1.5321**	(0.699)	.01817	1.7503***	(0.356)	3.3002***	(0.742)	.00095	2.9848***	(0.389)
SoffFARM 15 - 22	5.2587***	(1.514)	.03454	2.3947***	(0.393)	1.3523**	(0.666)	.00065	1.0980***	(0.355)
SoffFARM 22 - 31	0.6640	(0.964)	.01031	0.459	(0.538)	1.9879**	(0.895)	.00076	0.8618*	0.476)
Daughter										
DonFARM 5 - 15	-2.7371***	(0.988)	-.19790	-1.7359***	(0.456)	0.3539	(0.563)	.00025	0.0040	(0.299)
DonFARM 15 - 22	-2.6518	(3.063)	-.19953	-0.9602	(0.627)	1.4878	(1.213)	.00064	0.4080	(0.389)
DonFARM 22 - 31	-3.0601	(2.293)	-.28778	-1.9425*	(1.165)	-0.5835	(0.765)	-.00063	0.2418	(0.597)
DoffFARM 5 - 15	1.9298**	(1.003)	.0202	1.5008***	(0.356)	3.7467***	(0.741)	.00103	3.1365***	(0.386)
DoffFARM 15 - 22	1.0261	(0.905)	.0143	0.5256	(0.383)	0.7968	(1.055)	.00046	0.7165**	(0.336)
DoffFARM 22 - 31	4.3644	(2.981)	.02441	0.7439	(0.529)	0.2944	(0.654)	.00020	0.0368	(0.467)
Geographic Characteristics										
PACIFICO	-	-		-1.2149**	(0.608)	-	-		0.7736	0.698)
CENTRAL	-	-		-2.189***	(0.618)	-	-		0.7945	0.691)
ATLANTICO	-	-		-1.520**	(0.636)	-	-		0.4779	0.706)
DUM_YEAR2	0.2466	(0.417)	.00482	-0.023	(0.272)	1.7438***	(0.498)	.00120	1.24974***	0.2629)
DUM_YEAR3	0.6679	(0.610)	.01242	-0.162	(0.294)	1.9670***	(0.597)	.00134	1.31525***	0.2693)
CONSTANT	-	-		-3.027**	(1.221)	-	-		-5.50928***	1.0637)
N	1,677			1,677		1,677			1,677	
Wald chi2(31)				200.35***					234.88***	
Wald chi2(28)	55.84***					69.22***				
Log likelihood	-72.642			-421.87		-92.53			-577.88	

* p<0.10; ** p<0.05; *** p<0.01.
†Robust standard errors
£Marginal Effects

Table 2.3 Head and Spouse Off-Farm Wage Equations: Kyriazidou Estimates

Dep Var: Weekly off-Farm wage	Head		Spouse	
	Coeff	SE†	Coeff	SE†
EDUCHD	1.6864*	(0.9691)	-	-
EXPERHD	2.0413**	(0.7923)	-	-
EXPERHD2	-0.0265***	(0.0095)	-	-
EDUCSP	-	-	1.9597*	(1.1488)
EXPERSP	-	-	0.4456*	(0.2518)
EXPERSP2	-	-	-0.0122**	(0.0056)
LAND	0.1811**	(0.0816)	-0.0153	(0.0214)
HHSIZE	0.2032	(0.6263)	0.0562	(0.4535)
LIVT_ASSET	-0.0015*	(0.0008)	-0.0002	(0.0003)
CONSTANT	0.0934	(1.8420)	4.4741***	(1.6769)
N	211		271	
F	2.79**		2.08*	
R^2	0.118		0.041	

* p<0.10; ** p<0.05; *** p<0.01
†Standard Errors in parenthesis

Table 2.4 Head and Spouse Off-Farm Labor Supply Equations: Kyriazidou Estimates

Dep Var: Logarithm of weekly hours worked off-Farm	Head				Spouse			
	K		K-IV		K		K-IV	
	Coeff	SE†	Coeff	SE†	Coeff	SE†	Coeff	SE†
Head Characteristics								
WGoffHD	0.0628***	(0.0106)	-0.0652***	(0.0238)	0.0006	(0.0052)	0.0262**	(0.0122)
SHAWAGEHD	-0.0036	(0.0173)	-1.1996**	(0.5531)	-0.0808	(0.3223)	-0.1101	(0.3141)
AGEHD	0.0077	(0.0510)	0.0212	(0.0536)	-0.0210	(0.0148)	-0.0111	(0.0142)
AGEHD2	0.00009	(0.0005)	-0.0002	(0.0006)	-	-	-	-
EDUCHD					0.0891	(0.0716)	0.1065	(0.0846)
Spouse Characteristics								
WGoffSP	-0.0237***	(0.0045)	0.0695**	(0.0283)	0.0252***	(0.0065)	0.0053	(0.0241)
SHAWAGESP	-1.2152***	(0.4099)	-1.9746***	(0.5694)	-3.9298***	(0.4755)	-4.3363***	(0.4986)
AGESP	-0.0135*	(0.0090)	-0.0196	(0.0150)	0.0728**	(0.0346)	0.0821**	(0.0370)
AGESP2	-	-	-	-	-0.0012*	(0.0007)	-0.0015**	(0.0007)
EDUCSP	0.2284**	(0.1007)	0.4056***	(0.1203)				
HH and Farm Characteristics								
SHADOW INCOME	-0.2866**	(0.1270)	-0.2956***	(0.0021)	-0.0759	(0.1818)	-0.1586	(0.1971)
HHSIZE	0.0817	(0.0608)	0.1426**	(0.0676)	-0.0384	(0.0566)	-0.0359	(0.0600)
CHILD=< 5	-0.2162	(0.1909)	-0.7855***	(0.2348)	-0.2670	(0.1973)	-0.3503*	(0.2135)
REMITTANCES	0.00021	(0.0002)	0.00000	(0.0003)	-0.0001	(0.0002)	-0.0002*	(0.0002)
LIVT_ASSET	-0.0002	(0.0001)	-0.0002**	(0.0001)	-0.00002	(0.0000)	-0.00007**	(0.0000)
Young and Adult Children Working								
Son								
SonFARM 5 - 15	-0.5975***	(0.2416)	-0.78370**	(0.3255)	0.0198	(0.2051)	-0.0922	(0.2126)
SonFARM 15 - 22	0.0371	(0.2063)	-0.01259	(0.2814)	-0.2948	(0.2095)	-0.3780*	(0.2273)
SonFARM 22 - 31	-0.3123	(0.2445)	-0.46482	(0.3437)	0.2328	(0.3374)	0.1745	(0.3399)
SoffFARM 5 - 15	1.0789***	(0.3013)	1.1243***	(0.3928)	0.0582	(0.3216)	0.0715	(0.3438)
SoffFARM 15 - 22	0.4143	(0.3916)	1.3768***	(0.4459)	0.3704	(0.3375)	0.3623	(0.3613)
SoffFARM 22 - 31	0.0698	(0.4619)	-0.02921	(0.6943)	0.6792	(0.7860)	0.9691	(0.8396)
Daughter								
DonFARM 5 - 15	-0.3070	(0.2666)	-0.7492**	(0.3297)	-0.0007	(0.2457)	0.0437	(0.2512)
DonFARM 15 - 22	1.0228**	(0.4496)	0.8474*	(0.4999)	-0.4136	(0.7095)	-0.7093	(0.6715)
DonFARM 22 - 31	-3.0337	(0.5015)	-3.0567***	(0.5407)	0.3894	(0.4830)	0.1888	(0.5438)
DoffFARM 5 - 15	1.0605***	(0.3275)	0.5149*	(0.3227)	0.46566*	(0.2758)	0.6149**	(0.2620)
DoffFARM 15 - 22	0.6989**	(0.2982)	0.7717**	(0.3261)	0.1886	(0.3370)	0.5134	(0.3068)
DoffFARM 22 - 31	0.7192	(0.5126)	0.2969	(0.5168)	0.6087**	(0.4021)	1.0287**	(0.4085)
CONSTANT	-0.2015	(0.1502)	-0.3285*	0.1945)	0.3019	(0.1677)	0.3468**	(0.1701)
N	211		211		271		271	
F	40.48**		26.29***		9.74***		9.26***	
R^2	0.65		0.41		0.52		0.48	
Hausman Test (Chi2(25))	4.97		3.38		8.52		13.81	

p<0.10; ** p<0.05; *** p<0.01

†Standard Errors in parenthesis

Table 2.5 Test of the Equality of Estimated Marginal Product and Market Wages: Kyriazidou Estimates.

Dep Var: SHADOW_WAGE	Head		Spouse	
	K†	K-IV†	K†	K-IV†
WAGEOFF	-.00064	.00144	.0122	-.00103
	(0.00012)	(0.00118)	(0.0105)	(0.0038)
Constant	-.00195	-.00502	1.218	.01988
	(0.0160)	(0.01753)	(0.315)	(0.0175)
N	211	211	271	271
R^2	0.0046	0.0032	0.0028	0.0003
$F(2,209)^{\Delta}$	3.4e+07***	6.1e+05***		
$F(2,269)^{\Delta}$			4462.35***	36584.67***

*** p<0.01

†Standard Errors in parenthesis

$^{\Delta}$Test under the null Hypothesis: Ho: α=0 and β=1

ESSAY 3

Land Use and Agricultural Production in Nicaragua: A Fixed Effects Semiparametric Analysis

Introduction

- After 46 years of military dictatorship by the “Somoza" Dynasty (1936-1979) and ten years of civil war under the "Sandinista" political regime (1980-1990), the Nicaraguan rural sector exhibits a complex and challenging socioeconomic structure (IFAD, 2009).
- Small-scale farmers face distorted labor and credit markets, there are a significant number of poor landless or near of landless workers and the distribution of land is highly unequal (Foltz et al., 2001).
- Since most of Nicaragua’s rural poor people live in the vast dry central region where natural resources are limited, high population density has led to overexploited natural resources (IFAD, 2009).

The Debate

- Many authors suggest that access to land, and its role as a key factor of production, is a critical component for increasing rural income, absorbing surplus labor, and reducing poverty (Binswanger et al., 1995; Ravallion & Sen, 1994)
- Others, in contrast, argue that the contribution of additional land to per capita income would be relatively small, and alternative anti-poverty policy mechanisms, rather than expanding access to land, should be considered to alleviate poverty (Lopez & Valdez, 2000).
- The extent to which increasing the average farm size among peasant farmers could help alleviate poverty remains a subject of heated debate

Objectives

- To examine how farm size affects agricultural income, using a balanced household panel dataset for the years 1998, 2001 and 2005 for Nicaraguan farm households
- Contribution
  - To investigate how key unobservable inputs, such as ability and soil characteristics, affect agricultural production using panel data estimators for Nicaragua
  - The use of recent panel data semiparametric methodology to control for unobservable determinants while relaxing maintained hypotheses imbedded in parametric models

Theoretical Framework

- It follows a farm decision model that consider distortions in labor and credit market (Finan et al., 2005) shows that:

1. As tillable land per farm household increases, the allocation of on-farm labor also increases and the off-farm labor decreases
2. The marginal value product of household labor should rise, assuming the presence of under-employment, thus reducing the difference between the shadow and the market wage
3. As land availability per household increases, then access to credit and the use of purchased inputs also rise

Data (Same as Essay 2)

- The Living Standard Measurement Survey (LSMS), a nationwide household survey, carried out by the Nicaraguan Statistical Service and the World Bank during 1998, 2001 and 2005
  - Balanced Panel data
  - Farm land (titled or untitled owned, borrowed and/or rented) was not zero for at least two years of the survey
  - Household with a head and a spouse for all three years of the survey
- Balanced panel containing 559 observations

Econometric Framework

- Finan et al., (2005), using household data for Mexican peasant farmers, concluded that the relationship between farm income and land availability is complex and can be distorted in empirical work due to the use of fully parametric specifications
- These authors applied a more flexible model following Robinson (1988):
$$Y_i = \phi(L_i) + X_i^{'}\theta + \varepsilon_i \tag{1}$$
where Y_i is farm income, L_i is land endowment, X_i is a vector of farm and individual characteristics
- However, Finan et al., (2005) did not control for unobservable characteristics (e.g., motivation, managerial ability, soil characteristics) which is best done when panel data are available

Econometric Framework

- Consider the following partially linear model with a fixed effects component (PLFE):

$$Y_{i,t} = \phi(L_{i,t}) + X_{i,t}^{'}\theta + C_i + \varepsilon_{i,t} \tag{2}$$

- After the within transformation to get rid of unobserved heterogeneity C_i, equation above can be specified as

$$\ddot{Y}_{i,t} = \phi(L_{i,t}) - \phi(\bar{L}_i) + \ddot{X}_{i,t}^{'}\theta + \ddot{\varepsilon}_{i,t} \tag{3}$$

Econometric Framework

- To estimate the PLFE model, Henderson et al. (2008) proposed the following estimator

$$\hat{\theta} = \left[\sum_{i=1}^{N} \hat{X}_i^* \hat{X}_i^{*\prime} \right]^{-1} \left[\sum_{i=1}^{N} \hat{X}_i^* \hat{Y}_i^* \right] \quad (4)$$

- where $\hat{Y}_i^* = \ddot{Y}_{i,t} - \{\hat{\phi}(L_{i,t}) - \hat{\phi}(\bar{L}_i)\}$ and $\hat{X}_i^* = \ddot{X}_{i,t} - \{\hat{\phi}(L_{i,t}) - \hat{\phi}(\bar{L}_i)\}$ and the vector of parameters $\hat{\theta}$ is estimated using OLS and $\hat{\phi}(\cdot)$ is obtained interactively based on a nonparametric kernel estimation.

Results

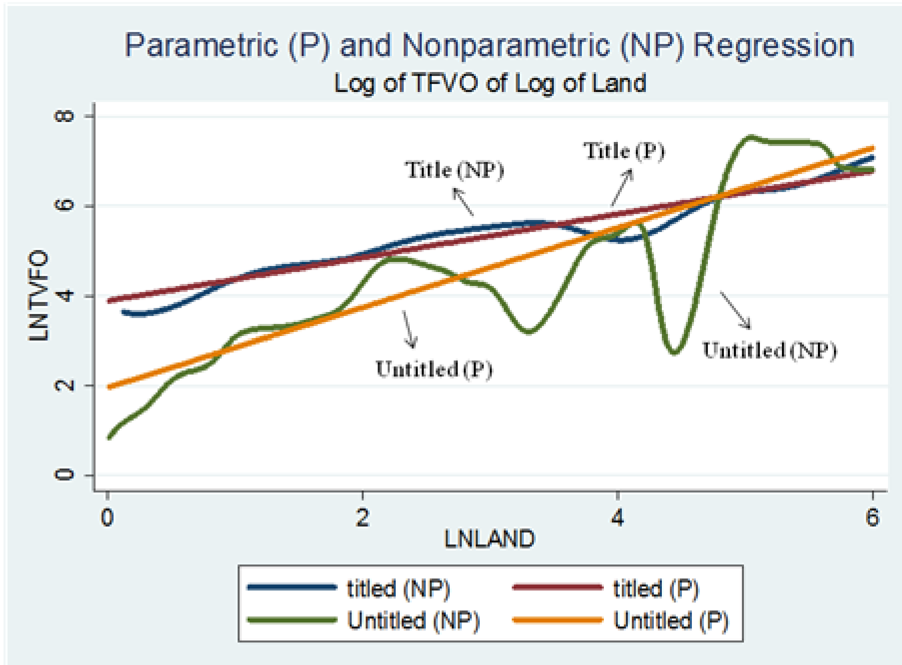

Figure 3.1 Parametric and Nonparametric Regressions of Log of TVFO on Log of Land (Pooled Data)

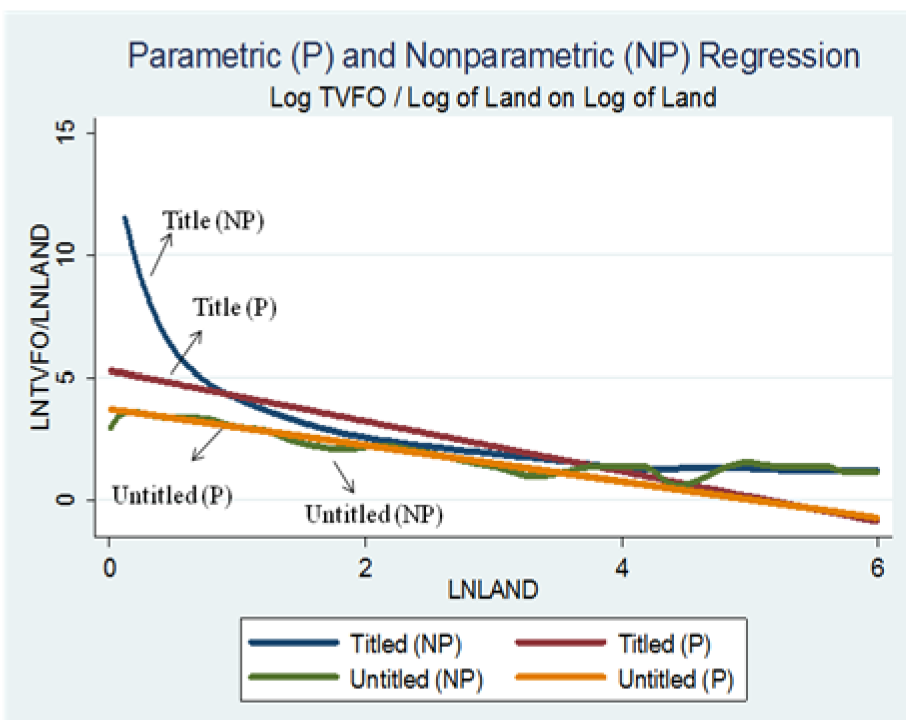

Figure 3.2 Parametric and Nonparametric Regressions of Log of (TVFO/Land) on Log of Land (Pooled Data).

Table 3.4 Production Function Estimates†

Variable	Pooled OLS	Semiparametric Robinson (1988)	FE OLS	Semi FE Henderson et al. (2008)
LNNLAND	0.1338**	0.8387***$^{\Delta}$	0.1656*	0.3727***$^{\Delta}$
	0.0566	*0.1051*	*0.0998*	*0.1069*
LNINPUT	0.4121***	0.3780***	0.3614**	0.3858***
	0.0365	*0.0338*	*0.0414*	*0.0314*
RENTLAND	0.5138***	0.5175***	0.5772***	0.3517*
	0.1422	*0.1531*	*0.1650*	*0.1411*
LNHIRED	0.2886***	0.2985***	0.2356***	0.2387***
	0.0518	*0.0551*	*0.0655*	*0.0472*
EDUCHD	0.0304	0.0369	0.1190**	0.0912*
	0.0349	*0.0365*	*0.0638*	*0.0537*
AGEHD	-0.0012	-0.0034	0.0132	0.0124
	0.0050	*0.0052*	*0.0099*	*0.0080*
LNHRonHD	0.2216***	0.2362***	0.2333**	0.2271***
	0.0346	*0.0370*	*0.0467*	*0.0380*
EDUCSP	0.0626**	0.0998**	0.1259**	0.1927***
	0.0332	*0.0493*	*0.0607*	*0.0525*
AGESP	-0.0013	0.0447*	-0.0080	-0.0016
	0.0045	*0.0356*	*0.0099*	*0.0071*
LNHRonSP	0.0899*	-0.0016	0.0923	0.1319***
	0.0488	*0.0048*	*0.0624*	*0.0489*
CREDIT	0.1026	0.0400	0.0757	-0.0258
	0.1320	*0.1444*	*0.1549*	*0.1283*
TITLE	0.5979***	0.5030***	0.7969***	0.6189***
	0.1311	*0.1368*	*0.1627*	*0.1246*
TRAINING	0.2062	0.1314	0.3935**	0.2935*
	0.1756	*0.1826*	*0.2005*	*0.1625*
ORGANIZ	-0.1734	-0.1857	-0.1281	-0.1325
	0.1622	*0.1726*	*0.1769*	*0.1648*
TEMP	1.1256***	1.1498***	1.0607***	0.9983***
	0.1797	*0.2103*	*0.2256*	*0.1693*
PERM	1.5342***	1.5443***	0.4851	0.5761**
	0.3352	*0.3268*	*0.4176*	*0.2952*
HORTA	0.3328**	0.3602**	0.0612	0.1166
	0.1384	*0.1605*	*0.1657*	*0.1611*
LIVEST	2.1175***	2.2131***	2.3725***	2.2998***
	0.3240	*0.3647*	*0.3864*	*0.2901*
TEMP*PERM	-0.8910***	-0.8972***	-0.4110	-0.3269
	0.3380	*0.3328*	*0.4059*	*0.2907*
TEMP*LIVEST	-0.6140**	-0.6671*	-0.7271**	-0.6806**
	0.3170	*0.3650*	*0.3841*	*0.2945*
PERM*LIVEST	-0.6671***	-0.6929***	-0.1873	-0.1131
	0.1930	*0.2426*	*0.2364*	*0.2150*
DUMYEAR2	-0.4134**	-0.4258***	-0.3380*	-0.6339***
	0.1666	*0.1785*	*0.1842*	*0.1421*
DUMYEAR3	0.4542***	0.4547**	0.4884**	0.2273
	0.1747	*0.1832*	*0.2073*	*0.1545*
SonFARM5-15	0.0633	0.0693	-0.0237	-0.3275**
	0.1246	*0.1376*	*0.1533*	*0.1286*
SonFARM15-22	0.4003***	0.3800***	0.4375***	0.3264**
	0.1188	*0.1282*	*0.1521*	*0.1284*
SonFARM22-31	-0.0577	-0.0137	-0.1458	-0.5648***
	0.1794	*0.1754*	*0.2194*	*0.1630*
DonFARM5-15	-0.3622**	-0.3772*	-0.5921***	-0.9166***
	0.1936	*0.1935*	*0.2070*	*0.1352*
DonFARM15-22	0.1062	0.0530	-0.2802	-0.7194***
	0.2499	*0.2387*	*0.2642*	*0.1786*
DonFARM22-31	0.0089	-0.0298	0.0154	-0.8287***
	0.3823	*0.3857*	*0.4129*	*0.2579*
PACIFICO	0.4581		-	-
	0.4392	-		
CENTRAL	0.7106*		-	-
	0.4364	-		
ATLANTICO	1.2315***		-	-
	0.4466	-		
CONSTANT	-1.1059**		-	-
	0.5092			
N	1677	1677	1677	1677
F test	99.760***	36.27***	35.73***	41.19***
R^2	0.49	0.373	0.467	0.403

*p<0.10;**p<0.05;***p<0.01. † Standard Errors are in italic below the coefficients.

$^{\Delta}$ The average derivative estimator was used to recover this coefficient (Stoker, 1992).

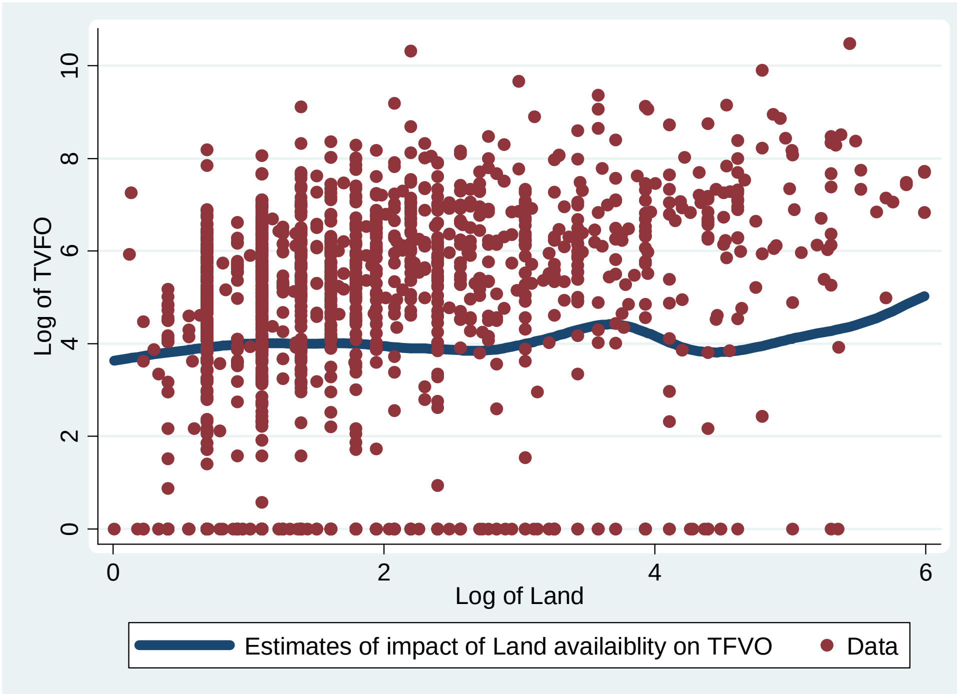

Figure 3.3 Nonparametric Estimates of the Impact of Land Endowments on TVFO

Concluding Remarks

- The general objective was to contribute to the understanding of the complex rural sector in two of the poorest countries in Latin America which have recently received little attention from the research community
- The strategy was:
  - To focus on two of the most important assets of peasant farmers, land and human capital
  - To use panel data along with methodological approaches which have had very limited applications in agricultural development research
- One major conclusion is that these methods have provided significant gains in robustness. An important implication is that more reliable policy recommendations related to development in Honduras and Nicaragua can be formulated

Concluding Remarks

- Nicaraguan and Honduran farmers are still strongly dependent on agricultural activities as the main source of livelihood. Thus, public incentives to encourage agricultural production might help not only to promote agricultural growth but also to absorb surplus labor
- Significant differences between heads and spouses regarding non-farm activities were observed, and female participation in both on and off-farm labor markets matter
- The contribution of additional land appears to have a small impact on agricultural income corroborating earlier results
- Agricultural development interventions that provide financial and technical support to peasant farmers is found to have a significant and positive impact on agricultural income for Honduras

Future Research

1. Impact of agricultural development policies vs urban-oriented policies for the rural sector
2. Nicaraguan and Honduran families are composed of large families, therefore labor supply from other members of household should be considered
3. The inverse relationship between farm size and productivity is again an important area of research. Exploring the labor absorption across farms of different sizes needs further attention
4. Semiparametric estimations are gaining in popularity; but their applications are still very limited, not only in the field of agricultural development but also in applied economics in general


Have a nice day!