Pathways towards prosperity in rural Nicaragua; or why households drop in and out of poverty, and some policy suggestions on how to keep them out[1]

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I.   INTRODUCTION

While Nicaragua over the past decade has ranked among the poorest countries in Latin America in terms of per capita GDP, data from the last three LSMS surveys (1993, 1998, and 2001) has shown a consistent, though modest, decline in the incidence of poverty. Nationally, the incidence of poverty among individuals has fallen from 50.3 to 45.8 percent over this period. Most poverty is concentrated in the rural sector (with an incidence of 67.8 percent) and in particular in the Central region (75 percent) (World Bank, 2002a). Given the dynamism of agriculture over the last decade, it is somewhat surprising that the reduction of rural poverty has not been greater. Further, this apparent slow, but stable decline in overall poverty incidence masks active movement at the household level in and out of poverty, particularly in the rural sector. At the household level it is much more difficult to find and explain an overall march towards increased living standards.

In this paper we analyze the dynamic of poor households moving in and out of poverty, using panel data from the 1998 and 2001 LSMS surveys. The availability of panel data offers an opportunity to analyze who and how households escaped or fell into poverty. What were the principal exit strategies used by households? What are the major determinants of exiting poverty and remaining in poverty? How do poor rural households achieve prosperity?

While we touch on both the rural and urban poor, we concentrate primarily on rural households, given their much larger numbers and greater heterogeneity. We apply a variety of methodologies in our analysis of poverty exit strategies. In Section II we provide some background information on the rural sector in Nicaragua, and in Section III we analyze changes in asset ownership and use as well as poverty status. We analyze who has left and entered poverty and provide a description of their characteristics. Given insufficient data points to separate chronic and transient poverty by econometric means, we will instead characterize these different groups of households in descriptive terms. In Section III we briefly describe the situation of agriculture, agricultural assets, and agrarian institutions, the basis of the rural economy in Nicaragua.

Next, in Section IV we use econometric methods to find the determinants of changes in welfare over the panel period as measured by consumption and income.   In the conclusions in Section V, we will bring these three types of analysis together and build a matrix of poverty exit paths combined with policy recommendations for specific categories of rural households.   Full results can be found in Appendices II, while a detailed discussion of panel data issues, most importantly that of attrition, can be found in Appendix I.

II.   BACKGROUND

While over a decade of reform has stabilized Nicaragua's macroeconomy, austerity measures and adjustment policies of the government of President Violeta Chamorro (1990-1996) worsened rural poverty. These programs reduced public spending and the fiscal deficit, restricted credit, privatized more than 350 state enterprises, liberalized the financial sector, liberalized domestic and foreign trade, and drastically downsized the state's role in agriculture (World Bank, 1995). These policies were continued, in large measure, by the administration of Arnoldo Alemán (1996-2002), which signed agreements with the IMF in 1997 and 1998, and by the current administration of Enrique Bolanos.

The high level of rural poverty has led recent governments to target the agricultural and livestock sectors as keys to Nicaragua's recovery and economic growth (MAG, 1998; GON, 2001). This strategic focus appears sound, as Nicaragua has the highest share in Central America of the primary sector in GDP, 30 percent in 2001, a share which has increased from 25 percent in 1990. Approximately 38 percent of the economically active population in 2001 was occupied in the primary sector, again an increase from 36 percent in 1990. Agriculture and livestock constitute the most dynamic sector of the economy, with an average annual growth rate of more than 8 percent from 1994 to 2001 (BCN, 2002).

The agricultural sector, however, faces the daunting challenge of maintaining these high growth rates. Recent studies show that most of the recent agricultural sector growth can be attributed to growth in the amount of land under cultivation, an expansion which cannot continue indefinitely (World Bank, 2002b; Rose and Niera, 1999). Agricultural labor shows low levels of productivity, and agricultural production is characterized by low levels of input usage, capital, and technology. Valdes and Bastos (1999) argue that stagnating labor productivity limits agriculture's role in reducing poverty. The current state of Nicaraguan agriculture, however, lends to potential diversification into two directions: organic farming and high input, modern agriculture.

The Nicaraguan government has shifted policy on the agricultural and livestock sector dramatically over the last two decades. During the Sandinista period (1979-1990) the government intervened heavily in the agricultural sector. The Chamorro government (1990-96) sought to reverse this policy by drastically reducing credit, liberalizing input prices, curtailing the government's technical assistance services, and liberalizing foreign and domestic output markets (Spoor, 1995). As in other countries undergoing similar reforms, neither the government nor the private sector promoted institutions to bring about competition in input and output markets, nor did credit or technical assistance increase. As such, markets became highly segmented, and few households had access to services (Davis, Carletto, and Sil, 1997).

The current government has acknowledged these microeconomic problems, and at least in its public discourse and programmatic documents has identified them as key bottlenecks to rural development in Nicaragua. A recent agricultural sector review by the World Bank reaches similar conclusions (World Bank, 2002b). Thus, as in other Latin American countries following stabilization and adjustment, Nicaragua's rural development requires more attention to microeconomic problems that inhibit the productivity and response capacity of producers (de Janvry and Sadoulet, 1997). Among these problems are failures in labor, land, insurance and product markets; the absence of agrarian institutions; and the inefficiency of public investment.

III.   CHANGES IN ASSET OWNERSHIP AND HOUSEHOLD WELLBEING OVER TIME

We use asset based typologies as well as outcome or choice based typologies to compare and analyze different categories of households over time.

Background on typologies

The use of rural household typologies has a long history in Nicaragua, particularly from the early years of the Sandinista period. Competing typologies differed in their interpretation of the importance of control over land, the hiring in of labor, and participation in off-farm activities. These typologies formed part of a debate on the agrarian structure in Nicaragua, which ultimately had important implications for the formation of policy during the Sandinista administration.

A new generation of agricultural and livestock producer typologies have been constructed for Nicaragua over the last few years. The key tradeoff inherent in building typologies of use in policymaking is between detail/disaggregation and statistical representativity. Davis, Carletto, and Sil (1997) construct two basic typologies, one based on land use, with five categories, and the second on cattle ownership, with four categories. These typologies were chosen for two reasons. First, land and livestock constitute the most important productive assets at the disposal of producers. Second, this categorization is statistically representative; that is, inferences may be drawn from these categories about similar producers nationwide. Secondary typologies were developed to analyze specific issues, such as corn and bean market participation and participation in off-farm activities.

Maldidier and Marchetti (1996) take a different approach, building upon the typologies of the early 1980s, and construct a disaggregated typology with 21 categories, based primarily on land and cattle ownership, agro-ecological conditions, and labor supply and demand. Such a typology, using data from case studies, provides a closer and more detailed approximation of producer types, and is more practical when developing policy interventions targeted to specific groups of producers. It is used by government, NGO, and international organizations in policy formulation. One example is the targeting of beneficiaries for the Agricultural Technology and Technical Education Project (IFAD, 1999).

However, such a detailed typology lacks statistical representativity. Inferences cannot be made with statistical certainty from case study data to the nation as a whole. Nitlapan-UCA (1995) attempts to apply the Maldidier and Marchetti typology to a large sample of producers, but most of the typology's categories have too few observations to make reliable inferences.

Changes in asset ownership and use over time

For this purpose Davis and Murgai (2000), in analyzing rural households in the 1998 LSMS survey, construct two statistically representative typologies. The first broadens the scope of agricultural producer or livestock typologies described above to include all rural households. The second is limited to those farm households who owned or used land for agriculture or livestock production during the survey period. The rural household typology takes into account the principal productive assets to which households have access. In rural Nicaragua these are land, cattle, and human, the latter divided into labor experience and education. Heads of cattle tend to be associated with access to land, so both are not needed. Education is used as a good proxy for labor market participation. Two variables then, land and education, are considered the exogenous assets which determine in

large part the choices made by Nicaraguan rural households. For this reason we use them to divide households into categories, expecting to find divergence in key choice variables.

Land assets are determined by what land households controlled during the survey period, regardless of whether the land is owned or rented. Households are categorized by farm size. Non-farm households are categorized by the average educational level of adults in the household. The category of urban farm households is also added for comparison.

The farm typology can be used to analyze issues specifically related to agricultural and livestock production. This typology distinguishes between owners and renters of land. If land markets were perfect, then there would be no useful distinction between owned and rented land, as operated land would not be determined by land ownership. Obviously land markets are not perfect, but are imperfect to varying degrees, which may be governed by parcel size. The rental market is very active in Nicaragua, particularly for small parcels, thus blurring the distinction between owner and renter. But agricultural households are often constrained in credit and insurance markets, which may imply further differences between owners, renters, and sharecroppers, again by parcel size. We believe that these constraints are sufficiently binding to merit separation of rental and owned households. Finally, urban farm households are mixed with rural farm households in the farm typology.

The panel data provide an opportunity to examine how asset ownership has changed overtime, and with this, to judge the exogeneity of assets upon which these typologies were built. In Table 1 we present a matrix based on crossing the 1998 rural typology with a rural typology using the same criteria, but based on the 2001 characteristics of the same households. We find that our exogenous assets in 1998 were in fact not so exogenous. Only 44 percent of households originally in the *minifundia* category are still there in 2001; 28 percent have obtained more land, either through renting or ownership; 27 percent no longer have land and have moved to the education categories. Similarly, only 34 percent of small landholders remain; 31 percent have lost land, and so on in each category. The education categories show more permanence; 61 percent remain in the low education category and 70 percent in the high category. For both categories, however, approximately 15 percent became *minifundistas*, primarily through land rentals, as we will see later. More surprisingly, 13 percent of low education households became high education, and 9 percent of the latter became low education households, most likely through changes in household composition.

Table 1. Matrix of 1998 and 2001 rural household typologies

in percent		2001							
		e-2 mzs	*2-5 mzs*	*5-20 mzs*	*>20 mzs*	*<4 yrs*	*> 4 yrs*	Total	Percent
	e-2 mzs	44	16	9	3	19	9	313	25
	2-5 mzs	31	34	13	10	8	4	182	14
1998	*5-20 mzs*	22	16	35	14	8	6	162	13
	>20 mzs	10	9	13	52	12	4	105	8
	<4 yrs	16	3	5	1	61	13	262	21
	> 4 yrs	14	2	2	2	9	70	250	20
	Total	317	163	140	112	282	259	1273	100
	Percent	25	13	11	9	22	20	100	

Looking only at farming households in 1998, in Table 2, we see similar movement. Only 31 percent of land owning *minifundistas* remain as such in 2001; 34 percent accumulate land, 12 percent become renting *minifundistas*, and 20 percent leave agriculture. Similarly, 29 percent of small farmers remain as such in 2001; 17 percent become *minifundistas*, 28 percent accumulate land, and 12 percent leave agriculture. Approximately 61 percent of medium and large farmers remain, however. Among households renting in, 35 percent of the renting *minifundistas* remain; 24 percent acquire their own land, and 32 percent leave agriculture. Among larger renters, however, only 13 percent remain, while 35 percent acquire land, 31 percent become renting *minifundia*, and 21 percent leave agriculture altogether. Non agricultural rural households are less likely to change categories, with around 75 percent remaining as such; moving households among these are redistributed in both rental and landholding categories.

Table 2. Matrix of 1998 and 2001 rural farmer household typologies

			owners			renters		non agriculture			
in percent			*owners*			*renters*		*non agriculture*		Total	Percent
		e-2 mzs	2-5 mzs	>5 mzs	e-2 mzs	>2 mzs	< 4 yrs	> 4 yrs			
	owners	e-2 mzs	31	19	15	12	3	15	5	121	9
		2-5 mzs	17	29	28	8	6	8	3	128	10
1998		>5 mzs	9	13	61	3	3	5	6	221	17
	renters	e-2 mzs	11	6	7	35	9	21	11	210	16
		>2 mzs	12	12	11	31	13	17	4	112	8
	non	< 4 yrs	3	2	5	14	3	61	13	272	21
	agriculture	> 4 yrs	5	1	3	10	1	9	70	260	20
		Total	135	124	236	205	61	293	269	1323	100
		Percent	10	9	18	15	5	22	20	100	

Urban households, as shown in Table 3, in general show less movement among categories of the typology, which is based almost exclusively on average education levels. Still, a number of households change categories as they move from agriculture to non agriculture (approximately 63 percent remain in this category), and others move among education categories. While most of this movement is found in increases in categories by education level, some households fall, again due presumably to changes in household composition.

Table 3. Matrix of 1998 and 2001 urban household typologies

in percent		**2001**					
		agriculture	*<4 yrs*	*5-8 yrs*	*>8 yrs*	Total	Percent
	agriculture	63	17	9	10	130	9
	<4 yrs	5	67	27	1	329	22
1998	*5-8 yrs*	3	13	63	22	597	39
	>8 yrs	3	1	11	86	471	31
	Total	128	320	529	551	1528	100
	Percent	8	21	35	36	100	

The rural typology of 1998, while flawed, does provide a basic categorization of households, and combined with information from 2001 we can reinterpret the 1998 typology in the analysis of changes among panel households. Most important is the identification of for the most part *minifundia* producers/rural wage laborers, with low levels of education, who move in and out of agriculture production and wage labor, primarily through the use of rental markets (which under our definition also includes sharecropping and borrowing land). Further along in this paper we will explore exit strategies using typologies based on changes in activities.

Changes in poverty category over time

Modest, but significant decreases are evident in the incidence of both extreme and moderate poverty among panel households from 1998 to 2001. Extreme poverty in rural areas fell from 22 to 19 percent, and moderate poverty from 38 to 35 percent. Overall, the share of rural households in poverty fell from 60 to 54 percent. Overall urban poverty fell from 23 to 21 percent. Most urban poverty is moderate; only 5 percent of panel urban households lived in extreme poverty in 1998, and 4 percent in 2001.

These modest changes mask large movements by rural households among categories in a poverty based typology, as seen in Table 4. Overall, the six percent drop in poverty is the net of 16 percent of households leaving poverty, and 10 percent entering. Another nine percent moved from extreme to moderate poverty, countered by seven percent who moved in the opposite direction. Among urban households much less change is evident, with approximately 80 percent remaining in the same category. As we shall see later, these movements vary widely among different categories of rural and urban households.

Table 4. Entering and exiting poverty, 1998 and 2001 panel households

in percent of households	total	rural	urban
Number of observations	2800	1273	1527
1998			
Extreme poverty	13	22	5
Moderate poverty	27	38	18
All poverty	40	60	23
2001			
Extreme poverty	11	19	4
Moderate poverty	25	35	17
All poverty	36	54	21
Overall			
Not poor in both 1998 and 2001	52	30	70
Exiting any kind of poverty to not poor	13	17	10
Entering any kind of poverty from not poor	9	11	7
Moderate poor in both 1998 and 2001	12	17	8
Exiting extreme poverty to moderate poverty	5	9	2
Entering extreme poverty from moderate poverty	4	7	2
Extreme poor in both 1998 and 2001	6	10	2

Poverty exit strategies

We begin our analysis of poverty exit strategies by looking at the characteristics of households according to a typology based on movement in and out of poverty categories. Poverty exit strategies are multiple and in the tables that follow are represented by the allocation of household labor and participation in different economic activities. In Table 5 some first hypotheses emerge, which will later be examined in a multivariate perspective as well.

Table 5. Household characteristics by poverty movement typology, rural

	year	units	total	Not poor in 1998 and 2001 (1)	Exiting any kind of poverty to not poor (2)	Entering any kind of poverty from not poor (3)	Exiting extreme poverty to moderate poverty (4)	Entering extreme poverty from moderate poverty (5)	Moderate poor in both 1998 and 2001 (6)	Extreme poor in both 1998 and 2001 (7)
# of observations			1193	320	192	123	114	93	210	141
household size	1998	#	6.00	4.52	6.46	4.79	8.58	5.99	6.38	7.93
	2001	#	5.85	4.44	5.26	5.78	7.25	6.59	6.48	8.14
education	1998	years	3.25	4.64	3.42	2.80	2.40	1.95	3.00	1.46
	2001	years	3.66	5.24	3.81	3.34	2.59	2.18	3.28	1.72
total land, adjusted	1998	mzs	10.02	14.08	14.09	8.34	6.74	3.44	6.48	6.76
	2001	mzs	9.44	11.68	8.51	14.57	13.75	3.96	5.91	4.95
in agriculture	1998 only	share	.13	.12	.08	.24	.14	.12	.11	.19
	2001 only	share	.11	.09	.13	.13	.07	.08	.13	.07
	never	share	.31	.48	.39	.16	.19	.15	.25	.20
	both	share	.45	.31	.40	.47	.59	.64	.51	.54
in livestock	1998	share	.22	.24	.20	.27	.21	.16	.23	.21
	2001	share	.23	.25	.28	.26	.21	.12	.23	.15
in non ag wage labor	1998 only	share	.11	.10	.20	.12	.06	.10	.09	.10
	2001 only	share	.16	.15	.11	.17	.22	.17	.16	.16
	never	share	.46	.36	.37	.49	.53	.63	.47	.64
	both	share	.28	.39	.32	.22	.20	.10	.27	.10
in ag wage labor	1998 only	share	.17	.12	.26	.15	.20	.13	.18	.13
	2001 only	share	.14	.08	.10	.18	.10	.25	.19	.22
	never	share	.46	.65	.45	.48	.34	.30	.42	.23
	both	share	.23	.15	.19	.19	.36	.32	.21	.42
planted	1998	share	.55	.40	.53	.60	.66	.73	.64	.61
	2001	share	.58	.43	.48	.71	.74	.76	.62	.73

First, demographic changes are key determinants of changes in poverty status. While the average size of households exiting poverty (column 2) drops 19 percent, for households entering poverty (column 3) it increases 21 percent. Similar changes are found for households exiting extreme to moderate poverty (column 4) and vice versa (column 5). Some of these changes are undoubtedly due to having more children (as only the entering poverty categories have on average more small children), and others stem from marriage, returning migrants, or other household fusions which increase or decrease family size. Data on the reasons for changes in household size can be found in Tables 6 and 7.

Table 6. Reasons for new household member LSMS 2001 with respect to 1998

	Number	Percent
Born after EMNV98	1046	13
Marriage	386	5
Went back with family	872	11
Hurricane Mitch	15	0
Came looking for job	61	1
Merge with another household	176	2
Mistakenly not surveyed in 1998	297	4
New family	5277	64
Does not know	131	2
Total	8261	100

Second, poverty categories are correlated with levels of average education. Not only are the levels of education correlated with those households remaining in their different poverty levels (column 1 vs. column 6 vs. column 7), but households exiting poverty have greater education, on average, then households entering poverty, as well as those remaining behind. Note that most households entering poverty are moderately poor; their characteristics constitute a mix between the moderate poor and the non poor. They do not have the typical characteristics of the extreme poor.

Table 7. Reasons for losing a household member from 1998

Where	Number	%
Moved: To another household in the same house	126	4
To another house in the same municipality	1678	53
To another municipality	800	25
To another country	355	11
Died	173	5
Does not know	26	1
	3158	100
Why		
For work	235	9
In search of work	68	3
Change of marital state	612	24
To study	101	4
To form a new family	1529	59
Benefited from housing programs	14	1
Other	45	2
	2604	100

Third, entering poverty and continually living in poverty is associated with agricultural activities. Households leaving poverty had on average less land in 2001 then in 1998, while households entering poverty accumulated more land. A higher share of exiters did not plant in either 1998 or 2001, a characteristic associated with lower levels of poverty overall, as can be seen in columns 1, 6, and 7. While among households exiting poverty the share with non agricultural wage labor fell over the panel period, only 37 percent had not worked in non agricultural wage labor over this period, again another trait shared with non poor households in both periods. Similarly, exiting households had a 16 percent drop in participation in agricultural wage labor, an activity commonly associated with poverty. 65 percent of the still non poor never participated in agricultural wage activities, while only 23 percent of the still extreme poor could say the same.

Thus, rural households escaping or exiting poverty tend to have the following characteristics—smaller family size, higher levels of education, more participation in non agricultural wage labor and non agricultural businesses, and less participation in farming or agricultural wage labor. Households in extreme poverty over the two periods have the highest family sizes, the lowest level of education, the worst dwelling characteristics, the highest dependency on farm agricultural activities and off farm agricultural wage labor, and the least participation in non agricultural wage labor. These are the characteristics of the chronic poor.

Urban

Urban households can be seen in Table 8. Differences are less evident between households entering and exiting poverty, and center primarily on changes in family size. These households (columns 2 and 3) are more similar to the still moderately poor then the non poor (column 1) in terms of lower levels of education and more participation in agricultural related activities. Columns 4, 5 and 7, which correspond to households moving in between extensive and moderate poverty and those remaining in extreme poverty, have too few observations to make conclusions.

Table 8. Household characteristics by poverty movement typology, urban

	year	units	total	Not poor in 1998 and 2001 (1)	Exiting any kind of poverty to not poor (2)	Entering any kind of poverty from not poor (3)	Exiting extreme poverty to moderate poverty (4)	Entering extreme poverty from moderate poverty (5)	Moderate poor in both 1998 and 2001 (6)	Extreme poor in both 1998 and 2001 (7)
# of observations			1603	1087	172	123	37	25	131	28
household size	1998	#	5.37	4.77	6.59	5.63	7.94	7.54	7.23	8.02
	2001	#	5.14	4.58	5.29	6.33	6.89	8.69	7.03	7.83
education	1998	years	6.59	7.67	4.52	4.67	3.17	2.13	4.24	1.90
	2001	years	7.10	8.17	5.40	4.94	3.54	2.46	4.60	2.06
total land	1998	mzs	3.08	2.90	.34	11.81	2.36	.07	1.44	1.17
	2001	mzs	2.61	2.92	1.73	1.02	1.82	.57	2.64	4.27
in agriculture	1998 only	share	.03	.03	.02	.05	.11	.04	.03	.07
	2001 only	share	.03	.02	.05	.06	.04	.04	.06	.06
	never	share	.89	.92	.86	.84	.64	.86	.82	.57
	both	share	.05	.03	.08	.06	.20	.07	.09	.31
in non ag wage labor	1998 only	share	.12	.11	.16	.16	.18	.19	.10	.16
	2001 only	share	.12	.11	.15	.16	.11	.06	.14	.17
	never	share	.16	.15	.16	.16	.15	.22	.11	.40
	both	share	.60	.62	.53	.52	.56	.53	.65	.27
in ag wage labor	1998 only	share	.05	.03	.08	.08	.15	.12	.10	.14
	2001 only	share	.04	.03	.03	.07	.04	.12	.08	.10
	never	share	.86	.92	.82	.76	.65	.41	.75	.44
	both	share	.05	.02	.07	.09	.16	.34	.07	.32
planted	1998	share	.08	.05	.12	.12	.25	.11	.15	.36
	2001	share	.08	.05	.09	.11	.31	.11	.12	.38

Analyzing changes in poverty through the rural and urban typologies

Analyzing poverty by the original rural typology, plus adding the educational based typology for urban households, provides further insight into poverty movements. This can be seen in Table 9. First, in rural areas, poverty gains are found more in the rural households that were not involved in agriculture in 1998; households in the low education category dropped the incidence of poverty from 63 to 49 percent, while in the high education category poverty incidence fell from 36 to 25 percent. *Minifundistas* and small farmers both experienced small poverty reductions, but overall poverty levels remained very high, just under 70 percent. Medium and large farmers fare worse; the incidence in poverty in the former rose from 51 to 61 percent, while for the large farmers the

incidence stagnated around 54 percent. These figures point to transitory poverty caused by exposure to risk associated with economic activities based on agricultural and livestock production.

Despite the slow movement on overall poverty levels, this apparent stagnation again masks wide fluctuations. For most categories, particularly the farmer and lower education categories, 40 to 50 percent of households changed poverty category. Stability is achieved only with increasing levels of education; 73 percent of rural high education category households, and 79 and 97 percent of urban middle and high education remain in the same poverty classification, almost all non poor. The only stability in the farmer categories is that of poverty, with 36 percent of *minifundistas* and 33 percent of small farmers remaining in their poverty categories.

Table 9. Poverty movements and household characteristics by 1998 rural typology

| | | | rural | | | | | | urban | | |
		total	e-2	manzanas 2-5	5-20	>20	years <4	>4	urban agri	<4	years 5-8	>8
# of observations		2797	315	183	162	104	263	249	129	327	598	466
Extreme poverty	1998	.13	.33	.27	.21	.23	.22	.05	.18	.12	.02	.00
Moderate poverty	1998	.27	.39	.47	.30	.30	.41	.31	.25	.34	.20	.03
Total	1998	.40	.73	.74	.51	.53	.63	.36	.43	.46	.22	.03
Extreme poverty	2001	.11	.29	.28	.17	.13	.20	.02	.11	.12	.00	.00
Moderate poverty	2001	.25	.40	.39	.44	.41	.29	.23	.30	.30	.18	.02
Total	2001	.36	.68	.66	.61	.53	.49	.25	.41	.42	.19	.02
Still extreme poverty		.06	.17	.12	.09	.09	.12	.01	.08	.05	.00	.00
Still moderate poverty		.12	.19	.21	.18	.13	.14	.15	.12	.14	.09	.01
Still not poor		.52	.17	.18	.30	.30	.28	.57	.47	.41	.70	.96
in agriculture	never	.63	.01	.01	.00	.04	.74	.79	.05	.95	.97	.97
	both	.23	.65	.82	.83	.72	.01	.01	.56	.00	.00	.00
	any year	.37	.99	.99	1.00	.96	.26	.21	.95	.05	.03	.03
in non agri wage labor	never	.29	.50	.60	.60	.72	.37	.20	.30	.25	.12	.10
	both	.45	.25	.12	.14	.06	.29	.56	.41	.43	.65	.71
in agri wage labor	never	.68	.35	.45	.53	.56	.39	.61	.70	.73	.89	.95
	both	.13	.30	.18	.22	.15	.27	.16	.08	.11	.03	.01
planted	1998	.31	.96	.97	.99	.92	.02	.01	.91	.00	.00	.00
	2001	.29	.69	.84	.84	.76	.25	.21	.60	.05	.03	.03

No clear patterns emerge, however, in terms of what determines which households in each category escape or enter poverty. While rural non farming households in 1998 are clearly better off than farmers, almost 25 percent of these households turn to planting in 2001. While *minifundistas* showed very modest poverty gains over the period, over 30 percent left agriculture. While from the table non farm wage labor activities are clearly associated in the long term with education and wealth, and agricultural wage labor the opposite, between 1998 and 2001 no clear pattern emerges in terms of poverty and who is moving in and out of these categories in the period.

In Table 10 we refer back to the land-labor typology used in Davis and Murgai (2000). In this typology, rural households were sorted into four land-labour combinations: households involved in neither non agricultural nor agricultural wage labour; those involved only in non agricultural wage labour; households involved only in agricultural wage labour; and those involved in both. Each category was then subdivided by access to land. At that point, in 1998, the only segments of the rural population that could not be considered poor as a group were non agricultural wage households and non farm households who do not participate in wage activities. Small farmer households were just as poor as landless agricultural wage households. The most destitute group, however, in rural Nicaragua were those households that depended on both agricultural wage and on farm activities.

Table 10. Household characteristics by land-labor strategy, rural

in share of households						non agricultural wage		agricultural wage		both wage	
			no wage								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		total	<3	>3	no land	land	no land	land	no land	land	no land
# of observations		1193	178	200	80	114	142	210	116	78	75
Extreme poverty	1998	.24	.27	.21	.10	.22	.08	.41	.32	.28	.15
Moderate poverty	1998	.38	.44	.37	.29	.36	.34	.35	.37	.54	.45
Total	1998	.63	.72	.58	.40	.58	.42	.76	.69	.82	.61
Extreme poverty	2001	.21	.34	.18	.12	.12	.06	.32	.25	.23	.13
Moderate poverty	2001	.36	.38	.44	.23	.37	.25	.37	.38	.45	.24
Total	2001	.57	.72	.63	.35	.49	.32	.69	.63	.68	.37
planted	1998	.63	.99	.95	.02	.98	.00	.97	.00	.97	.00
	2001	.61	.77	.88	.16	.65	.19	.80	.44	.70	.32
in non agri wage labor	1998 only	.12	.00	.00	.00	.35	.28	.00	.00	.43	.33
	2001 only	.16	.23	.21	.34	.00	.00	.22	.30	.00	.00
	never	.50	.77	.79	.66	.00	.00	.78	.70	.00	.00
	both	.23	.00	.00	.00	.65	.72	.00	.00	.57	.67
in agri wage labor	1998 only	.16	.00	.00	.00	.00	.00	.37	.32	.45	.57
	2001 only	.15	.39	.21	.17	.28	.14	.00	.00	.00	.00
	never	.45	.61	.79	.83	.72	.86	.00	.00	.00	.00
	both	.24	.00	.00	.00	.00	.00	.63	.68	.55	.43

Bringing back this typology in the context of panel data helps illustrate a more appropriate categorization of households, as well as emphasizing the temporality or flexibility among land-labour strategies. Based on the 1998 categories, the poorest of the poor continue to be *minifundia* with no wage labour activities, and agricultural wage workers with some agricultural activities, with over 70 percent total, and 30 percent extreme, and with almost no change over the panel period. As earlier, within this apparent stagnation both categories showed great fluidity in poverty movements, with the agricultural wage labour category becoming primarily moderately poor, the *minifundia* category primarily extremely poor, and with approximately 50 percent of households in both categories changing poverty classification.

Comparison of these two categories over time reveals the disappearing differences in terms of composition, between the two. Almost 40 percent of the *minifundia* households have a member working in agricultural wage labour in 2001, 23 percent in non agricultural wage labour and 23 percent have left agriculture all together. Similarly 36 percent of the exclusively agricultural wage worker households leave agricultural wage employment, 22 percent participate in non agricultural wage labour, and approximately 20 percent leave agriculture. A similar category, landed households participating in both agricultural and non agricultural wage labour, with comparable poverty levels, experienced similar changes, with 45 percent leaving agricultural wage labour, 36 percent leaving non agricultural wage labour, and 27 percent leaving agriculture.

Three clear messages emerge from this classification. First, across labour categories, those with land in 1998 fare worse in terms of poverty than those without land, and this differentiation has increased over time. This is true for non agricultural wage labourers and for households that have both. Agriculture—particularly for the smallest and poorest—does not appear to be much of an exit strategy. Second, non agricultural wage labour is preferable to participating in both agricultural and non agricultural wage labour, which is better then just agricultural wage labour in 1998. The incidence of average poverty for those involved in only non agricultural wage labour or both falls 33 percent, while for agricultural wage it falls approximately 13 percent. Third, the incidence of overall poverty for farming only households with more then 3 hectares actually increases from 57 to 63 percent, though this is primarily moderate poverty. These households, which in many cases have substantial land and cattle holdings and produce the bulk of the nation's food, live in relatively

isolated areas (evidenced by the lowest level of access to electricity and greatest time to schools) suffered over this period. Larger landholders dependent on agricultural activities are associated with transitory poverty attributable to risk. Over 20 percent turned to agricultural wage labour and 20 percent to non agriculture wage labour, while 11 percent left agriculture altogether.

III.   AGRICULTURE, ASSETS, AND AGRARIAN INSTITUTIONS

All recent administrations in Nicaragua have stressed that agriculture forms the foundation of the country's economy. In terms of percent of GDP and the economically active population, it is indeed the motor of the economy, and its success is crucial to the alleviation of poverty, both transitory and chronic, in Nicaragua. Yet agriculture is different from other sectors of the economy, in at least two crucial factors. First, input and output markets often do not function very well, particularly in a country like Nicaragua with a low level of infrastructure development and producer asset accumulation. Second, agriculture is more risky than other economic activities. A special set of agrarian institutions is necessary to overcome these market failures.   In this section we briefly look at agriculture, access to agricultural assets and agrarian institutions, as well as a description of successful producers.

Agriculture

Overall, the structure of agricultural production does not appear to have changed much from 1998, as would be expected in so short a time and given the sampling properties of the LSMS, which do not allow much detail in agricultural production. The share of agricultural producers producing each crop is generally the same, as seen in Table 11. Out of the universe of all households who produced in a given year or both years, corn and beans are the dominant crops, involving over 75 percent and 56 percent, respectively, of all producers. The share of households producing fruits and vegetables has increased to 73 and 25 percent in 2001, respectively. Sorghum (18 percent), tubers (11) and coffee (11) follow.

Table 11. Share of farmer households planting, by year and region

in shares		Overall			1998				2001				Both years			
		1998	*2001*	*Both*	*Atlantic*	*Central*	*Managua*	*Pacific*	*Atlantic*	*Central*	*Managua*	*Pacific*	*Atlantic*	*Central*	*Managua*	*Pacific*
corn	1998	.75		.80	.72	.81	.57	.72					.74	.87	.49	.75
	2001		.76	.78					.75	.79	.73	.71	.80	.81	.66	.74
sorghum	1998	.23		.21	.01	.21	.25	.33					.01	.17	.21	.35
	2001		.18	.20					.00	.19	.11	.26	.00	.22	.15	.27
tubers	1998	.15		.17	.60	.08	.09	.09					.61	.09	.15	.09
	2001		.11	.12					.46	.06	.00	.05	.48	.07	.00	.07
beans	1998	.56		.61	.53	.74	.18	.41					.56	.78	.21	.43
	2001		.62	.65					.74	.77	.26	.40	.74	.82	.21	.43
vegetables	1998	.16		.17	.08	.16	.21	.17					.09	.19	.25	.18
	2001		.25	.26					.13	.24	.17	.32	.10	.26	.21	.34
fruits	1998	.65		.64	.75	.63	.80	.60					.79	.63	.80	.57
	2001		.73	.73					.77	.67	.88	.76	.78	.67	.93	.78
coffee	1998	.10		.12	.04	.19	.00	.02					.05	.22	.00	.02
	2001		.11	.12					.06	.19	.00	.03	.07	.21	.00	.04
planted	1998	1.00		1.00	1.00	1.00	1.00	1.00					1.00	1.00	1.00	1.00
	2001		1.00	1.00					1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

As with overall participation in agriculture, each crop shows overall stability in shares, masking large movements in and out of agricultural production. Few conclusions can be drawn from analysis of these movements, except that those producing the three major crops (corn, beans, and sorghum) in both years have higher levels of poverty than those moving in and out of production (not shown). Coffee producers, who have been hit hard by the fall in international prices,[2] surprisingly do not show any trends in terms of poverty levels between those who move in and out of coffee production, those who remain, and those who were never involved.

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[2] See BCN (2001) for a description of the situation of coffee producers in Nicaragua over the panel period.

In regional terms (again Table 11), corn still dominates everywhere, with over 70 percent of all producers in 2001, in every region, planting this crop. Bean and coffee production are focused in the Central region, sorghum in the Pacific, and tubers in the Atlantic. The only major changes over the panel period involve vegetables and fruits both of which are planted by increasing numbers of farmers in the Pacific region.

Market participation

Important changes have occurred, however, in terms of market participation. Agricultural producers overall are highly integrated with markets. Approximately 70 percent of agricultural households in both years sold some portion of their agricultural production. Further, since 1998 market participation in corn and beans has increased. As seen in Table 12, among households growing corn in both periods, the share of these who are self sufficient and neither selling nor purchasing corn fell from 45 to 31 percent. Of self sufficient producers in 1998, only 35 percent remain so, with 33 percent selling corn in 2001 and 19 percent supplementing on farm production with purchases. The share of those who sell increased from 29 to 37 percent. Of the 2001 sellers, however, only 40 percent sold in 1998 as well; another 40 percent were self sufficient in 1998. Of these households not producing corn in 1998, and doing so in 2001, 40 percent were self sufficient in corn, and 30 percent sold surplus production.

Table 12. Categorization of corn producer market participation, 1998 and 2001

		Corn producers, 1998						
		none	both	buyer	self	seller	Total	Percent
	none	0	21	55	119	68	262	
	both	22	4	9	28	14	55	11
Corn producers, 2001	buyer	47	4	34	42	19	99	21
	self	93	6	28	80	37	150	31
	seller	69	17	21	72	71	180	37
	Total	231	30	92	222	141	485	100
	Percent		6	19	46	29	100	

Note: none refers to farmers who produced corn in either of the years, but not both.

A similar trend is evident in bean production, seen in Table 13, as the share of self sufficient producers falls to 24 percent from 34 percent, deficit producers fall from 24 to 21 percent, and excedent producers increase from 31 to 37 percent. "New" bean producers in 2001 are evenly split (~28 percent) between deficit, self sufficient, and excedent producers. Overall, corn and bean markets have become increasingly less segmented, reversing the trend found in Davis and Murgai (2000) when comparing this data with the 1998 LSMS data and a 1996 national agricultural household survey (Davis, Carletto, and Sil, 1997). Changes in market participation depend not only on market structure and transaction costs, but also changes in production levels, prices, household demographic characteristics, and productive assets. We are not able to conduct a formal study as to the determinants of market participation at this time, but clearly it constitutes an important consideration for examining the relevance of agriculture as a poverty exit strategy.

Table 13. Categorization of bean producer market participation, 1998 and 2001

		Bean producers, 1998						
		none	*both*	*buyer*	*self*	*seller*	Total	Percent
	none	0	21	70	63	39	193	
	both	34	16	25	15	20	76	18
Bean producers, 2001	*buyer*	65	9	30	24	24	87	21
	self	64	5	22	47	24	98	24
	seller	61	15	25	53	58	151	37
	Total	222	47	101	139	125	412	100
	Percent		11	25	34	30	100	

Note: none refers to farmers who produced beans in either of the years, but not both.

Agricultural assets

On a positive note, access to and ownership of land appears to have broadened, as seen in Table 14. For land in annuals production, average land size in the largest land holder category has decreased, and for every other category it has increased. A number of households in the education categories, both rural and urban, have obtained land, in accordance with the same trends in switching in and out of agricultural production we have seen elsewhere. A similar pattern is true for land rented in, though not for land in pasture, where the land structure remains the same. These changes, along with the overall flexibility of entering and exiting agricultural production, point to a functioning land rental market, which appears to be playing an important role in access to land. Calculation of Gini coefficients, shown in Table 15, confirms the broadening access to land, with particularly large decreases in inequality in land in annuals and total land. Note the reduction in consumption inequality as well, in both rural and urban households.

Table 14. Agricultural assets by 1998 rural typology

					rural						**urban**			
		units	total overall	total rural	e-2 mzs	2-5 mzs	5-20 mzs	>20 mzs	<4 yrs	> 4 yrs	urban agri	<4 yrs	5-8 yrs	>8 yrs
# of observations			2797	1193	315	183	162	104	263	249	129	327	598	466
land in annuals	1998	mzs	3.87	6.54	.52	2.45	8.71	60.90	.00	.00	19.19	.00	.00	.00
	2001	mzs	3.80	6.25	3.23	7.57	10.19	32.01	1.41	.93	8.65	.87	.26	2.35
land in perennials	1998	mzs	.26	.53	.03	.16	.63	5.18	.00	.00	.29	.00	.00	.00
	2001	mzs	.22	.32	.10	.08	1.04	1.73	.04	.02	.21	.00	.01	.39
land in pasture	1998	mzs	1.65	1.92	.00	.17	1.88	20.35	.00	.00	16.73	.00	.00	.00
	2001	mzs	1.51	2.25	.00	.69	2.91	21.54	.00	.14	8.81	.00	.08	.36
total land, adjusted	1998	mzs	5.78	9.00	.54	2.86	11.22	86.43	.00	.00	36.21	.00	.00	.00
	2001	mzs	5.63	8.96	3.34	8.40	14.45	56.17	1.52	1.10	18.18	.87	.35	3.10
total land, rented in	1998	mzs	.90	1.81	.91	1.39	3.04	12.35	.00	.00	1.62	.00	.00	.00
	2001	mzs	.92	1.29	1.53	1.06	2.55	3.43	.49	.29	6.35	.04	.15	.02
heads of cattle	1998	#	1.48	2.27	.61	1.97	3.20	16.80	.18	.14	9.43	.01	.02	.01
	2001	#	1.48	2.44	.89	2.44	3.10	15.32	.48	.69	5.99	.05	.09	.36

Table 15. Gini Coefficient for selected assets

Over all rural households	Total 1998	Total 2001	Panel 1998	Panel 2001
Per-capita consumption	.3878	.3689	.3653	.3612
Average education	.4761	.4598	.4565	.4353
Total owned land	.8765	.8455	.8629	.8628
Land in perennials owned	.9967	.9903	.9951	.9890
Land in annuals – owned	.9243	.8880	.9232	.9037
Rented land in annuals	.9258	.9013	.9265	.9138
Cattle	.9316	.9178	.9187	.9161
Over all urban households				
Per-capita consumption	.4507	.4290	.4444	.4154
Average education	.3126	.3177	.3044	.3009

Agrarian institutions

In terms of access to agrarian institutions, however, the situation is desperate, as can be seen in
Table 16. Already extremely low levels of access to credit and technical assistance stagnated or
further fell over the panel period. Of households involved in agricultural production in both years,
the share using technical assistance fell from 16 to 13 percent. The share receiving credit went from
9 to 10 percent, and the share participating in producer organizations from 9 to 11 percent. Most
surprisingly, however, and rather shocking, the share of agricultural households that used these
services in both years is even lower: five percent for technical assistance, two percent for credit, and
three percent for organizations (not shown). Technical assistance was provided evenly by
government and NGO sources, in both years. Credit came primarily from NGOs and organizations.

Table 16. Access to agrarian institutions

	1998	*2001*
number of obs:	1184	1184
TA exists in community	.24	.26
used TA	.16	.13
provided by govt	.07	.05
provided by NGO/project	.06	.05
credit for agriculture	.09	.10
from bank	.02	.02
from NGO/organization	.06	.08
from friend	.03	.01
credit for non agriculture	.01	.02
organization or project	.09	.11

On the other hand, agrarian institutions tend to be, and should be, combined together in a package,
as was noted in Davis and Murgai (2000) and Davis, Carletto and Sil (1997). Whether in
agricultural and/or livestock production and in either or both years, the majority of households
participating in producer organizations (Table 17) received technical assistance (provided evenly by
government or NGOs), and approximately a quarter received credit (almost exclusively from an
organization or NGO). Similarly, of those receiving technical assistance (Table 18), approximately
20 percent received credit, and from a third to a half participated in an organization or project.
Finally, for those receiving credit (Table 19), from 20 to 30 percent also used technical assistance
and participated in an organization.

Table 17. Access to agrarian institutions, by participation in producer organizations

	Household participated in a producer organization			
	only in 1998	*only in 2001*	*never*	*in both years*
number of obs:	67	80	1014	23
TA exists in community, 1998	.73	.28	.16	.74
TA exists in community, 2001	.22	.69	.18	.74
TA used, 1998	.64	.25	.08	.74
TA used, 2001	.09	.54	.07	.64
credit for agriculture, 1998	.20	.05	.08	.35
credit for agriculture, 2001	.05	.28	.06	.25
credit for non agriculture, 1998	.07	.01	.01	.07
credit for non agriculture, 2001	.00	.10	.03	.11
organization or project, 1998	1.00	.00	.00	1.00
organization or project, 2001	.00	1.00	.00	1.00

Table 18. Access to agrarian institutions, by use of technical assistance.

	Household used technical assistance			
	only in 1998	*only in 2001*	*never*	*in both years*
number of obs:	123	90	931	40
TA exists in community, 1998	1.00	.08	.09	1.00
TA exists in community	.16	1.00	.13	1.00
TA used, 1998	1.00	.00	.00	1.00
TA used, 2001	.00	1.00	.00	1.00
credit for agriculture, 1998	.20	.08	.07	.11
credit for agriculture, 2001	.08	.21	.06	.22
credit for non agriculture, 1998	.04	.01	.01	.07
credit for non agriculture, 2001	.02	.10	.03	.06
organization or project, 1998	.34	.03	.03	.46
organization or project, 2001	.11	.38	.03	.55

Table 19. Access to agrarian institutions, by use of agricultural credit

	Household used agricultural credit			
	only in 1998	*only in 2001*	*never*	*in both years*
number of obs:	83	76	1007	18
TA exists in community, 1998	.41	.25	.19	.44
TA exists in community	.22	.45	.20	.64
TA used, 1998	.26	.16	.12	.37
TA used, 2001	.10	.33	.09	.17
credit for agriculture, 1998	1.00	.00	.00	1.00
credit for agriculture, 2001	.00	1.00	.00	1.00
credit for non agriculture, 1998	.01	.01	.02	.04
credit for non agriculture, 2001	.06	.09	.03	.00
organization or project, 1998	.21	.06	.06	.21
organization or project, 2001	.08	.28	.07	.31

Success in agriculture

While agriculture is clearly associated with continuing poverty, 40 percent of the still non poor and over 50 percent of exiting households depend in part on agriculture. Thus agriculture has a potential to serve as a path out of poverty, which is not surprising, given the importance of agriculture in the rural economy. Risk and income instability constantly threaten agricultural dependent households in Nicaragua, and precious few reach a sufficient level of assets to mitigate the constant risk of falling into poverty.

In Table 20, we compare the characteristics of those agricultural households remaining in the same poverty categories over the two years.[3] Wealthy (or "still non poor") farmers obviously have more assets, in terms of different kinds of land and cattle assets, then the "still poor" farmers, but the most notable difference is the diversification into livestock production. More then half of the still not poor farmer households had cattle holdings at some point compared to only approximately 30 percent for extremely poor farmers. Almost 40 percent of wealthy farmers had cattle holdings in both periods, compared to 23 and 16 percent for the moderately and extremely poor. Herd sizes are much larger for the non poor (11 versus 2.5 versus 1 for the extremely poor), as well as size of pasture land, suggesting large scale production.

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[3] Numbers are not sufficient to classify agricultural households by the complete poverty movement typology.

Table 20. Assets holdings of agricultural households (in either year), by poverty status

				households still living in		
				non	*moderate*	*extreme*
		units	**total**	*poverty*	*poverty*	*poverty*
# of observations			1184	164	140	112
land in annuals	1998	mzs	10.18	15.11	9.01	9.02
	2001	mzs	10.08	15.40	8.57	5.47
land in perennials	1998	mzs	.68	3.65	.10	.19
	2001	mzs	.59	.61	.18	.48
land in pasture	1998	mzs	3.87	16.16	1.30	.39
	2001	mzs	3.75	15.45	1.38	.75
total land, rented in	1998	mzs	2.41	2.71	1.94	1.21
	2001	mzs	2.40	8.24	1.80	3.49
heads of cattle	1998	#	3.77	12.16	1.90	1.10
	2001	#	3.75	11.01	2.50	.94
in livestock	1998 only	share	.09	.06	.13	.11
	2001 only	share	.10	.10	.09	.04
	never	share	.61	.47	.54	.68
	both	share	.20	.37	.23	.16

The relationship between agriculture and poverty has a strong regional dimension, as can be seen in Table 21. The agricultural households still in extreme poverty are located primarily in the Central region, while the still rich are located disproportionately in the Pacific region and Managua. This is not a surprise and reflects conventional wisdom.

Table 21. Regional distribution of agricultural households (in either year), by poverty status

		households still living in		
in share of households		*non*	*moderate*	*extreme*
	total	*poverty*	*poverty*	*poverty*
# of observations	1184	164	140	112
Atlantic	.13	.09	.14	.18
Central	.45	.39	.48	.65
Pacific	.35	.43	.38	.17
Managua	.08	.09	.00	.00

In terms of crops grown, as seen in Table 22, producers in all three poverty categories are remarkably similar. The vast majority of all producers grew corn, though the use of this crop may differ. While a similar share market their corn, much of the wealthy corn producers use corn as an input into cattle production, while for the still poor it is consumed primarily by the household. A higher percentage of the poor produce beans and a higher percentage of the rich produce vegetables, though these differences may not be statistically significant. Strong differences emerge in the use of agricultural inputs, with around twice as many wealthy households using high yield variety seeds, fertilizers, and pesticides. Three times as many wealthy producers receive credit, though their overall level—fifteen percent—is exceedingly low. These producers also have a much greater level of farming equipment.

Table 22. Cropping patterns and technology use, by poverty status

in share of households		total	households still living in		
			non poverty	moderate poverty	extreme poverty
# of observations		1184	164	140	112
corn	1998	.62	.70	.85	.84
	2001	.60	.71	.79	.79
beans	1998	.46	.49	.67	.62
	2001	.48	.52	.66	.70
vegetables	1998	.13	.19	.16	.11
	2001	.20	.34	.27	.17
coffee	1998	.08	.11	.10	.14
	2001	.09	.13	.10	.15
HYV	1998	.05	.09	.03	.06
	2001	.08	.15	.06	.08
fertilizers	1998	.33	.57	.43	.14
	2001	.34	.59	.45	.22
pesticides	1998	.42	.58	.57	.41
	2001	.41	.61	.53	.37
technical assistance	1998	.14	.19	.11	.17
	2001	.11	.17	.09	.13
agri credit	1998	.09	.15	.09	.06
	2001	.08	.15	.15	.04
producer org	1998	.08	.13	.06	.07
	2001	.08	.16	.07	.06
corn, self sufficient	1998	.46	.46	.47	.36
	2001	.20	.26	.26	.23
beans, self sufficient	1998	.33	.25	.39	.35
	2001	.12	.13	.20	.14
sold any crop	1998	.54	.69	.70	.55
	2001	.53	.72	.67	.65
# work animals	1998	.70	1.41	.59	.51
	2001	.87	1.77	1.10	.66
# pesticide applicators	1998	.31	.61	.25	.19
	2001	.42	.71	.51	.33
well	1998	.07	.15	.05	.01
	2001	.07	.17	.12	.00

Rich and poor producers identify in equal shares drought (~70 percent), infestations (~65 percent), and low prices (~50 percent) as their principal problems, as seen in Table 23. The still poor complain more about the distance to market and lack of roads suggesting that for these households transaction costs are a major impediment to commercializing surplus production. All complain about high input prices and lack of capital, while the poor emphasize lack of financing.

Table 23. Problems mentioned by agricultural households, by poverty status

		households still living in		
in share of households		*non*	*moderate*	*extreme*
	total	*poverty*	*poverty*	*poverty*
# of observations	1184	164	140	112
Drought	.56	.72	.73	.71
Infestations	.55	.62	.69	.69
Low prices	.42	.54	.53	.51
Point of sale too far	.11	.10	.12	.21
No road	.03	.02	.05	.10
Little demand	.10	.15	.18	.06
High input prices	.37	.45	.57	.35
Lack of capital	.27	.32	.43	.35
Lack of financing	.27	.20	.31	.39

The conclusion is that the truly successful on farm producers are those that have diversified into large scale livestock production, thus reducing the exposure to risk, and on the other hand larger farmers with a certain level of accumulation of assets. Agricultural producers still living in moderate poverty employ modest levels of agricultural technology, but complain most about high input prices and lack of capital and financing. The extreme poor are constrained by high transaction costs, lack of financing, and low levels of agricultural technology. Presumably many of these poor producers are potentially viable but lack access to key agrarian institutions, as discussed earlier in this section.

IV.   DETERMINANTS OF WELFARE

In the previous section we have told a story, in descriptive terms, of the causes of movements in and out of poverty over the panel period. Now we are interested in assessing econometrically the effect of labor activities, policy instruments and household characteristics on the dynamic of poverty. Our aim is to be able to assert with some statistical certainty our conclusions of the previous section.

We use two indicators or proxies for household well being: consumption and income. Consumption is the most accepted indicator in statistical surveys for household well being, and is often preferred over income as it is less prone to short term variation. Income is used to purchase consumption, but households have many strategies to smooth consumption in the face of income variations. Consumption analysis allows assessing the contribution of household assets and characteristics and other explanatory variables to overall well being, but household assets and characteristics affect consumption through the mediation of income. Utilizing data on income by source allows us to characterize the role of assets and characteristics on the basis of household livelihood strategies. A description of the theoretical and practical implications of using these two proxies can be found in Appendix II.

We look first at the results of the consumption equations and then at income.

Consumption

Rural poor

We focus first on poor households, rural and urban, and then on non poor households. A summary of results for the consumption equations is found in Table 24, with full results in Appendix II. The results for the rural poor provide a clear message. Agricultural activities, both off and on farm, did not serve as a poverty exit strategy during the panel period, confirming our earlier discussion. Higher levels of consumption are obtained through allocation of household labor to non agricultural activities, both wage and self employment. Meanwhile, allocation of household labor to on farm agricultural activities is unambiguously associated with lower levels of per capita consumption. This does not mean that all on farm agricultural activities are associated with poverty; in fact, ownership of a greater number of heads of cattle is associated with higher levels of consumption of the poor, suggesting that certain types of asset accumulation in agriculture increases welfare. The negative sign on the share of household allocation to agriculture implies decreasing returns to agricultural labor and suggests that household surplus labor finds refuge in on farm production.

Table 24. Summary, consumption equation results

	Poor				Non poor			
	Rural		Urban		Rural		Urban	
	C level	C quant.	C level	C quant.	C level	C quant.	C level	C quant.
PATHS – LABOR								
Share of adults, agricultural wage			-	-			-	-
Share of adults, non agricultural wage	+							-
Share of adults, non agricultural self employed	+	+	-			+		
Share of adults, agricultural self employed	-	-	-				+	
POLICIES								
Hh average years of education	+	+	+	+	+	+	+	+
Paved access to home			+				+	+
ASSETS								
Cattle [n. of cows]	+	+			+	+	+	+
Value of assets for non agricultural business			+	+	+		+	+
Home asset index	+	+	+	+	+	+	+	+
DEMOGRAPHIC								
Family size	-	-	-	-	-	-	-	-
Dependency ratio	-	-	-	-		-	-	-
Head of household age	+				+	+	+	

+ or – indicates the sign of the significant (at 10 percent) variables
C level = 2001 level of logarithm of consumption, robust OLS
C quant. = 2001 level of logarithm of consumption, quantile regression

Second, education is strongly associated with increased levels of consumption among the poor. This is the expected result, and justifies current programs which emphasize increased access to education among the rural poor. Third, household size is strongly associated with decreased levels of consumption. Fourth, rural poverty has a strong regional component. Living in the Central region, compared to the Pacific, is unambiguously associated with lower levels of consumption. While this regional bias is in part historical, with the Central region traditionally comparing unfavorably to the modernized agricultural production of the Pacific region, it is likely that the fall in coffee prices have also played a role in the faltering economic performance of the Central region. This is particularly relevant for the rural poor who are dependent on agricultural wage labor from coffee, which generates annually 1/3 of agricultural employment (BCN, 2001).

Thus, while agriculture shows some hint as a potential exit strategy, during the panel period poor rural households primarily increased their welfare through non agricultural economic activities and education.

Urban poor

The results for the urban poor provide a somewhat mixed message. Allocation of household labor to agricultural activities (both wage and self employed) is associated with lower levels of consumption. Surprisingly, the same is true for non agricultural self employment. We suggest a similar interpretation as with the rural poor and agricultural self employment. Non agricultural self employment serves as the activity of last resort for the urban poor when other types of employment are not available. This interpretation is supported by the positive coefficient on non agricultural business assets, implying that the greater the size of the business in 1998, the higher the level of consumption in 2001. We are surprised, however, that non agricultural wage labor is not significant, as we expected such employment to serve as a major poverty exit strategy for the urban

poor. We suggest that this variable is too blunt and requires further disaggregation into types of non agricultural wage labor.

Second, nevertheless, average household education level is strongly associated with greater levels of well being. Third, as with the rural poor, household size is associated with lower welfare. Finally, urban poverty also has a regional dimension, though in this case households located in Managua have significantly higher levels of well being.

Rural and urban non poor

The story changes when looking at the non poor. Here we combine our discussion of rural and urban households. First, little effect is found in the allocation of household labor. The lack of significance in part could derive from the overly heterogeneous non agricultural wage labor category, which lumps together skilled and unskilled labor. Nevertheless, multivariate analysis shows that agricultural wage labor is associated with lower consumption in urban areas. One surprise is the positive sign on agricultural self employment for urban households, which in this case likely captures wealthy urban agricultural and livestock producers, an interpretation which is confirmed by the positive coefficient on livestock. Ownership of cattle is associated with greater welfare also for the rural non poor. Ownership of non agricultural business assets is associated with greater welfare.

Second, as among poor households, education is strongly associated with higher levels of consumption. Third, also as among poor households, household size is associated with lower welfare, though age of the household head is associated with greater welfare. Fourth, the rural and urban non poor diverge in terms of regional effects. While for rural households, there is some evidence of the Central region being worse off then the Pacific, for the urban non poor all regions are unambiguously better off than the Pacific.

Income

Rural poor

We focus first on the rural poor, with results of both the probits and selectivity corrected income equations in Table AII-4. Agricultural wage employment is clearly the economic activity of the poorest of the poor. Higher levels of education and home assets, the long term wealth proxy, as well as previous participation in non agricultural wage labor, are associated with a lower probability of participation in this activity. Instead, historical participation, as well as higher levels of non agricultural business assets, increases the probability of participation in agricultural wage employment in 2001. It is difficult to understand the positive role of non agricultural business assets. Similarly, previous participation in non agricultural wage labor is also associated with a lower probability of participation in on farm agricultural activities. Cattle ownership and previous participation positively influence participation in on farm activities.

Education is, on the other hand, associated with participation in non agricultural wage labor. Greater levels of agricultural assets have the opposite effect; households with more annual land and with previous experience in on farm activities are less likely to participate in non agricultural wage labor.

Living in the Atlantic region is negatively associated with wage activities, while it increases the probability or being self employed in agriculture. Non agricultural self employment is less likely to

be chosen in the Central region, and is the only activity where gender of the household head matters—in this case, women have a greater probability of participation. Finally, while historical participation in on farm activities is negatively associated with non agricultural self employment, some complementarities exist: members of agricultural organizations are more likely to be engaged in non agricultural business.

Very little of the variability in the level of income is explained by the variables considered. Quite surprisingly, for example, there is no significant relationship between level of income and share of work allocated to agricultural activities. Income from self employment in agriculture is instead positively correlated with affiliation with an agricultural producer organization and with cattle ownership. It is interesting to note the complementarity between non agricultural business income and land holding.

Urban poor

For the urban poor (Table AII-6), education reduces the probability of participating in agricultural wage labor, but surprisingly is not correlated with the level of any kind of income. Instead, historical labor activities dominate (mostly as substitutes) as well as regional factors. For the urban poor agricultural wage activities are more likely in the Atlantic and Central regions, non agricultural wage employment in the Pacific (compared to Atlantic and Managua), non agricultural self employment in the Pacific (compared to the Atlantic and Central) and agricultural self employment in the Atlantic region. Once again female headed households are more likely to participate in non agricultural self employment.

Rural and urban non poor

For the rural non poor (Table AII-5), the role of agricultural assets in generating income can finally be seen. Ownership of land and livestock assets leads to an increase both in the probability of participation and in the level of income derived from on farm labor.

Female headed households again are more likely to participate in non agricultural self employment, and are less likely to participate in any agricultural activity. Non agricultural self employment, again found more often in the Pacific and Managua regions, has complementarities with agricultural land. Education is important in the selection and in increasing income from non agricultural wage employment.

For the urban non poor (Table AII-7), education is associated with a higher probability of selection and higher returns from non agricultural wage labor, while it reduces participation in agricultural wage labor and non agricultural business. Cattle ownership reduces the probability of participation in non agricultural business, while it is positively associated with agricultural self employment and its income.

V.   CONCLUSIONS

The overall drop in poverty from 1998 to 2001 in Nicaragua is rather modest. However, these apparently small changes mask large movements in and out of poverty categories. While characterizing these movements with only two points in time is somewhat like separating out white caps from swells in a wind swept sea, the data do provide some hints as to populations and policy levers. Such difficulty should not be surprising given the precarious nature of employment and self employment in Nicaragua. In rural areas, agriculture is the primary source of wealth. In urban areas, welfare stability is found in the formal sector, based on education. The most relevant government task is to support the generation of wealth and to bring stability to the principal sources of income in both urban and rural areas.

In policy documents over and over again the government has correctly stressed the primary importance of agriculture to the poor and in reducing poverty. The data from this survey—and in fact all recent national household surveys—show, however, that the government has failed to successfully promote the livelihood strategies of farming households.   Farmers lack access to the classic agrarian institutions (credit, technical assistance, producer organizations) necessary for successful agriculture. Most farmers are mired in poverty or at constant risk of falling into poverty, and the most consistent economic activity associated with poverty is agriculture.

Livelihood strategies are in constant flux, particularly among the rural poor. Households show a continual pattern of accumulation and deaccumulation of production assets and movement in and out of economic activities. The rural non poor and particularly the urban non poor exhibit much more stability of employment. The poorest of the poor in Nicaragua are composed of an unstable mix of *minifundia* and agricultural wage workers and a combination of the two. The bulk of the rural poor move in between these categories in search of subsistence with surprising alacrity. These households are located primarily in the Central region. Agriculture, whether on farm or off farm as agricultural wage labor, is associated with continued poverty. Instead, access to off farm opportunities is the key source of differentiation among the rural poor.

Agriculture, however, still plays a key role in rural Nicaragua. For the rural poor it serves as the economic activity of last resort, and it functions as a fundamental survival strategy. For many households among the rural non poor it is the principal economic activity. However, many medium and large sized landholders have fallen into poverty or are at constant risk of doing so. Further, the availability of agrarian institutions and basic infrastructure necessary for efficient commercial production in agriculture is still lacking.

The role of education in overcoming poverty is fundamental across all household groups and in both rural and urban areas. No matter how estimated education is a crucial determinant of increased well being. These results suggest that the expansion of targeted interventions such as the Red de Protección Social (RPS, or Social Protection Network, see IFPRI (2002))—which provides cash to extremely poor households in return for sending their children to school and having health checkups—to a greater number of eligible households nationwide should be considered.

In terms of female headed households, participation in non agricultural self employment activities plays a primary role in assuring survival and increasing household well being, for both the rural and urban poor.

Policy matrix

A matrix of policy instruments and poverty exit strategies for rural households can be found in Table 25. The principal components of this matrix are the following:

Poverty exit strategies

Minifundia, landless rural, and agricultural wage laborers

The poorest of the poor in Nicaragua are the group of *minifundia* and agricultural wage workers. These households are characterized by low levels of all assets and instability of employment. Agriculture and agricultural wage labor constitute survival or subsistence strategies. They do not constitute poverty exit strategies, except for those few able to accumulate a sufficient level of assets. Instead, for these households non agricultural self employment and wage labor, including migration, as well as a direct transfer program such as the RPS, constitute the principal potential paths out of poverty.

Small producers

Small producers face essentially the same situation as the group above, but increased land holdings provide somewhat more potential to succeed in agriculture.

Medium producers

These households have agriculture and livestock production as the primary economic activity, and in fact produce the bulk of the country's agricultural production—but most still live in poverty. For most of these producers, agriculture has and could still constitute a path out of poverty, yet necessary support from the state is insufficient. These producers lack formal insurance mechanisms, exposing them completely to the risk inherent in agricultural production, and fostering risk adverse production strategies. These producers also lack access to credit and technical assistance, as well as basic infrastructure, which together could improve productivity and commercial potential.

Large producers

As households accumulate land and in particular diversify into livestock production, the probability of falling into poverty drops substantially and the need for government assistance with it. Still many large producers live in poverty, and clearly these households depend on agriculture as their potential escape route from poverty. As with medium sized producers, they lack formal insurance mechanisms and access to credit, technical assistance and basic infrastructure.

Policy recommendations

1. Expansion of coverage of RPS, complemented with additional programs to form a comprehensive and sustainable social protection network.

    a. The econometric and descriptive analysis shows that education is a key element for all poverty exit strategies, but particularly for the poorest of the poor in both urban and rural areas. In marginal rural areas, particularly in the Central region, the expansion of RPS to more eligible households, as well as expanded support for children in fourth and fifth grades, should be considered.

b. In the short term, direct cash transfers and other income support programs, such as workfare, are the most viable poverty exit strategy for the chronic poor. Rural households in extreme poverty are condemned to remain as such, dependent on subsistence agriculture and agricultural wage employment as survival strategies in the short term, as they develop human capital, some accumulate agricultural assets, and the economy creates better job opportunities.

c. In order to assure its sustainability, this transfer program should be altered to promote investment in productive activities as well, or at a minimum coordinate activities with microfinance programs. This is particularly crucial for female headed households in poverty, both rural and urban, who rely disproportionately on non agricultural self employment and need funds for investment.

2. Development of a strategic plan for agricultural and livestock production in order to take advantage of the comparative advantages of small, medium, and large Nicaraguan producers. With macroeconomic biases more or less under control, such a plan would focus on microeconomic and sectoral problems in maintaining high levels of growth in the agricultural sector and would provide the basis of regional development in Nicaragua and the creation of agricultural and non agricultural employment. The plan should contain the following elements[4]:

a. Foster competitiveness (the modernization of agribusiness, the promotion of agricultural exports, and improving the effectiveness of public spending)
b. Facilitate access to agrarian institutions (credit, insurance, technical assistance, and producer organizations)
c. Improve the functioning of land and labor markets through continuing to resolve land title issues and providing incentives for households to invest in education, as described above
d. Given Nicaragua's vulnerability to natural disaster, improve risk management. Special emphasis should be given to recent innovative proposals in rain insurance.

3. A second set of agricultural policies should be directed towards *minifundia* and small producers. In the absence of formal social insurance mechanisms, many households in extreme poverty rely on subsistence agricultural production to assure their survival. These households also require and deserve better access to basic agrarian institutions, even if of a smaller, more informal nature. The government has shown itself quite capable of extending technical assistance to the poorest households (even if overall access to these services remains low), and this effort should be expanded to include access to microcredit, markets, insurance, and further accumulation of agricultural assets and capital.

4. Continued emphasis needs to be placed on basic infrastructure, such as improve roads and electricity. Such infrastructure is central in improving agricultural productivity and facilitating input and output markets. Infrastructure also contributes to business development and facilitates access to job markets.

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[4] Many of these recommendations come from the World Bank (2002b).

Table 25. Policy matrix

			RURAL POOR (Categories 1 and 2)	
			minifundia/rural landless/agricultural wage labourers	small producers
			PROSPERITY STRATEGIES	
			1. non agricultural self employment (including migration) 2. non agricultural wage labor (including migration) 3. for a few with potential, agriculture 4. direct cash transfers	1. non agricultural self employment (including migration) 2. non agricultural wage labor (including migration) 3. for those with potential, agriculture 4. direct cash transfers
POLICY INSTRUMENT	ASSET ACCUMULATION	education	develop non agricultural alternatives	develop non agricultural alternatives; improve farm productivity
		land (ownership and rental)	agriculture as subsistence, risk averse strategy	enable small scale, economically viable activities
		cattle	livestock used for savings and risk	livestock used for savings and risk
		small business	essential for female headed households, and as non agricultural alternative	essential for female headed households, and as non agricultural alternative
		physical capital	agriculture as subsistence, risk averse strategy	enable small scale, economically viable activities
	AGRARIAN INSTITUTIONS	formal rainfall or crop failure insurance	agriculture as subsistence, risk averse strategy	enable small scale, economically viable activities
		producer organizations	facilitate access to institutions, markets, and economies of scale	facilitate access to institutions, markets, and economies of scale
		credit	microcredit	microcredit
		market information	NA	NA
		extension/technical assistance	agriculture as subsistence, risk averse strategy	enable small scale, economically viable activities
	POPULATION	family planning	permit households to plan family size	permit households to plan family size
	SOCIAL PROTECION	cash transfer programs (including RPS)	foment household human capital development and reduce consumption poverty directly	foment household human capital development and reduce consumption poverty directly
		old age pensions	with RPS, not necessary	with RPS, not necessary
	REGIONAL PLANNING	economic clusters	develop non agricultural alternatives	develop non agricultural alternatives; enable commercial agriculture
	INFRASTRUCTURE	roads, electricity, water, and sanitation	improve productivity and access to input/output markets and jobs	improve productivity and access to input/output markets and jobs

Table 25. Policy matrix (continued)

			RURAL POOR (Categories 3 and 4)	
			medium producers	**large producers**
			PROSPERITY STRATEGIES	
			1. for those with potential, agriculture **2. for those without potential, off farm activities**	**1. for those with potential, agriculture** **2. for those without potential, off farm activities**
POLICY INSTRUMENT	**ASSET ACCUMULATION**	education	develop non agricultural alternatives; improve farm productivity	develop non agricultural alternatives; improve farm productivity
		land (ownership and rental)	enable commercial agriculture, including exports	enable commercial agriculture, including exports
		cattle	enable commercial agriculture, including exports	enable commercial agriculture, including exports
		small business	NA	NA
		physical capital	enable commercial agriculture, including exports	enable commercial agriculture, including exports
	AGRARIAN INSTITUTIONS	formal rainfall or crop failure insurance	enable commercial agriculture, including exports	enable commercial agriculture, including exports
		producer organizations	facilitate access to institutions, markets, and economies of scale	facilitate access to institutions, markets, and economies of scale
		credit	enable commercial agriculture, including exports	enable commercial agriculture, including exports
		market information	enable commercial agriculture, including exports	enable commercial agriculture, including exports
		extension/technical assistance	enable commercial agriculture, including exports	enable commercial agriculture, including exports
	POPULATION	family planning	NA	NA
	SOCIAL PROTECION	cash transfer programs	NA	NA
		old age pensions	NA	NA
	REGIONAL PLANNING	economic clusters	enable commercial agriculture and vertical integration	enable commercial agriculture and vertical integration
	INFRASTRUCTURE	roads, electricity, water, and sanitation	improve productivity and access to input/output markets, and thus enable commercial agriculture	improve productivity and access to input/output markets, and thus enable commercial agriculture

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APPENDIX I. NOTES ON THE DATA

Our analysis is based on data from the LSMS for Nicaragua, collected in 1998 and 2001, ostensibly on the same households in both years. These data should have provided a panel of approximately 4,000 families, with information on demographic characteristics, assets, economic activities, income and consumption.

The chief problem we encounter is that approximately 25 percent of the households surveyed in 1998 are no longer in the sample in the following round; that is, they are not observed in 2001[5]. This is a relatively high figure, but not surprising given that the unit of observation in the sample design was the house (or vivienda) and not the household. Thus no effort was made to search for 1998 informants who were no longer residing in the same dwelling.

Only 3,015 households are included in both in 1998 and 2001. Table AI-1 shows some relevant variability in the incidence of attrition among different 1998 categories of households. Once we weight the data, the share of households which drop out of the sample ranges between 20 percent and 33 percent. ANOVA analysis in Table AI-2 shows that the differences are statistically significant.

Table AI-1. Incidence of attrition in different household groups.

Type of household 1998 typology	Panel	Dropping (Attrition)	Total	Incidence of attrition [weighted]
Not classified	0	3	3	
1. Rural agric. land size 0-5 mzs	570	169	739	22%
2. Rural agric. land size 5-20 mzs	190	63	253	20%
3. Rural agric. land size >20 mzs	155	70	225	25%
4. Rural non-ag. av. Educ. <4 years	259	123	382	29%
5. Rural non-ag. av. Educ. >4 years	192	65	257	33%
6. Urban average education <4 years	476	186	662	29%
7. Urban average education >4 years	1173	362	1535	22%
Total	3015	1041	4056	

Table AI-2. Analysis of the variance and comparison of mean of attrition in different groups.

Attrition	Coefficient	Std. Error	t	P>|t|
Constant	.225	.011	21.38	.000
Household type				
1	-.006	.020	-.29	.770
2	-.020	.031	-.65	.515
3	.030	.037	.81	.420
4	.069	.024	2.84	.005
5	.107	.025	4.35	.000
6	.064	.020	3.15	.002
7(dropped)				
Number of obs = 4053				

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[5] Rates of attrition of this magnitude are common in panel data sets in poor countries. For some examples, see Alderman et al. (2000).

Of the 3,015 households surveyed in both periods, we dropped 23 families which split into 47 units between the first and the second round, making the comparison of the dynamic of poverty more difficult. Furthermore, we are forced to exclude 171 households for which some members were mistakenly not surveyed in 1998[6]. Hence, we are left with 2,796 panel households, following the distribution found in Table AI-3.

Table AI-3. Distribution of panel households.

Type of household	Panel	With omitted members	Splitting	Total
Rural agric. land size 0-5 mzs	538	22	10	570
Rural agric. land size 5-20 mzs	176	10	4	190
Rural agric. land size >20 mzs	139	14	2	155
Rural non-ag. av. educ. <4 years	233	22	4	260
Rural non-ag. av. educ. >4 years	186	6	0	191
Urban average education <4 years	438	34	4	476
Urban average education >4 years	1086	64	23	1173
Total	2796	172	47	3015

ANALYSIS of Attrition

Attrition may be caused by a number of factors. Households may migrate temporarily or permanently for labor or personal reasons, civil unrest, banditry, or natural disaster. Informants may be out on errands when the surveyor is in town, and in some case informants may simply refuse to participate again. Laxness on the part of supervisors and surveyors can also lead to "disappearing" households, particularly in difficult to access areas of a census segment. In Tables AI-4 and AI-5 we present some details on attrition in the 2001 LSMS. For approximately 60 percent (635) of missing households, surveyors found the original dwelling, but with a new household, who was then surveyed. End of story. For the remaining 413 households, no new household was living in the house to survey. Most dwellings were abandoned, in some cases the house no longer existed or could not be found, and approximately 20 percent of the old households refused to participate.

Table AI-4. Attriting families by appearance on LSMS records

	Same dwelling, different household	Participated, or reason given for not participating	Total
Panel households	0	2968	2968
Attrition	635	413	1048
Total	635	3381	4016

With 1,048 households lost, attrition may constitute a major problem. Panel attrition is a problem for economic analysis when it is not random and we are not able to control for household characteristics which influence the probability of dropping out of the sample. In the words of Hausman and Wise, "attrition which is related only to the exogenous variables in a structural model does not lead to biased estimates, since these variables are controlled for in the statistical analysis.

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[6] For 65 of these households missing observations involve only children (aged less than 15 in 1998), hence these household observations could be recovered by changing 1998 data and programs (demographic characteristics of the family and all the per-capita variables should be adjusted). For the other 106 families where adults were omitted, the problem is more complex as the information on labor, income and consumption is thus misreported.

However, if attrition is related to endogenous variables, biased estimates result" (1979, p. 462). The loss of part of the sample is then a problem in two cases: 1) when the probability of attrition is related to the dynamic of the dependent variable[7]; 2) when the problem depends on exogenous variables, but we do not observe these variables or we are not able to properly account for them.

In order to assess the relevance of attrition, we perform four kinds of analysis.
- First, we compare the initial characteristics of the two groups in order to see if the families which drop out of the sample differed, in 1998, from the households which stay in the panel.
- Second, we perform a multivariate regression to find out which variables influence the probability of attrition, while controlling for other socio-economic characteristics.
- Third, we follow Fitzgerald et al. (1998a and 1998b) and perform a test based on the comparison of the coefficients of ordinary (OLS) and weighted least square (WLS) regression (hereafter FGM test).
- Fourth, we perform Heckman regression and check if the correlation between the error terms of the equations which explain the variation in consumption and the probability of attrition is significantly different from zero. When this is the case regular econometric techniques lead to biased and inconsistent estimates.

Table AI-5. Reason for missing in 2001

Interview outcome (first attempt)	Freq.	Percent
is not a dwelling	9	2
dwelling uninhabited	119	29
dwelling destroyed	13	3
dwelling under construction	3	1
dwelling does not exist	56	14
complete interview	39	9
incomplete interview	23	6
inhabitant absent	37	9
dwelling not found	48	12
refused to participate	66	16
Total	**413**	**100**

Interview outcome (second attempt)	Freq.	Percent
is not a dwelling	9	2
dwelling uninhabited	119	29
dwelling destroyed	13	3
dwelling under construction	3	1
dwelling does not exist	56	14
complete interview	5	1
inhabitant absent	37	9
dwelling not found	42	10
refused to participate	66	16
refused to participate, second round	31	8
inhabitant absent, second round	23	6
dwelling uninhabited, second round	3	1
dwelling inaccessible	6	1
Total	**413**	**100**

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[7] In our analysis, a drop in consumption may force the household to move, migrating in search of better conditions. This, however, may depend on the variation in some of the explanatory and independent variables of the model, which we could conceivably control for.

Initial characteristics

Table AI-6 presents the means of the main household characteristics for panel and attriting households, together with the difference and a test of significance of this difference[8]. We immediately notice that panel households are characterized by a lower level of consumption, which makes them look as initially worse off. However, the difference is not statistically different from zero at a significance level of 10 percent. Consumption of the attriting households has a higher variance. Median consumption is very similar in the two groups, and actually higher for panel families. As consumption is the dependent variable in our analysis, particular care must be paid to determining if this difference can lead to biased results.

Panel households are significantly bigger (5.7 vs. 4.9 members), more likely female headed and with an older head. Their average level of education is higher, but the difference is not significant. The difference in family size is due to a greater number of both children and adults. As for agricultural activities, neither the share of members self employed in agriculture nor asset holdings (land and cattle) are statistically different. However, panel households use technical assistance more often and are less likely to be credit constrained. Furthermore, they are characterized by a lower share of adult members employed in agricultural wage labor.

Despite the similarity of the share of adults employed in non agricultural business activities (self employed), households which drop out of the sample hold a much higher value of business assets (about 10,000 Córdobas vs. 4,000). As far as concerns housing, panel families are more likely to be owner of the dwelling they live in, which has also a higher rate of electrification and tends to be located in less marginal areas (shorter distance from a hospital). They also own more home assets (mainly appliances) and are more involved in social organizations at the community level. Finally, attrition is more likely in the Atlantic and Central regions, and less likely in the Pacific area.

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[8] The test is performed by regressing the variable on a constant and on a dummy for households which drop out of the sample (ATTRITION). In the regression:

$$X = b0 + b1 * ATTRITION + u$$

b0hat = [mean(X) for panel households] and
b1hat = [mean(X) for dropping households] - [mean(X) for panel families]
b1hat is the difference between the means in the two groups. The t-test on b1hat tells us if the difference is significantly different from zero.

Table AI-6. Comparison of 1998 characteristics of panel and attriting households.

VARIABLE	PANEL	ATTRITING	DIFF.	Test
Per-capita consumption	7716	8335	620	
Atlantic region	.075	.137	.062	signif. 10%
Central region	.304	.335	.031	signif. 10%
Managua	.284	.268	-.015	
Pacific region	.338	.260	-.078	signif. 10%
Share of adults, agricultural wage	.110	.163	.053	signif. 10%
Share of adults, non agricultural wage	.314	.310	-.004	
Share of adults, non agricultural self employed	.151	.158	.007	
Share of adults, agricultural self employed	.126	.126	.000	
Hh average years of education	5.196	5.012	-.184	
Used technical assistance	.047	.028	-.019	signif. 10%
Received pension	.045	.045	.000	
Credit constraint	.339	.373	.034	signif. 10%
Running water in or outside house	.611	.589	-.022	
Electricity	.708	.632	-.076	signif. 10%
Paved access to home	.215	.196	-.020	
Cattle [n. of cows]	1.435	1.525	.090	
Adjusted size of land	4.356	4.961	.605	
Rented in: size of land in annuals	.827	.642	-.185	
Value of assets for non agricultural business	4021	10231	6210	signif. 10%
Member of agricultural organization	0	0	-.003	
Family size	5.676	4.920	-.757	signif. 10%
Dependency ratio	.347	.375	.028	signif. 10%
Female headed household	.283	.237	-.046	signif. 10%
Head of household age	46.332	42.069	-4.263	signif. 10%
Head of household speaks indigenous lang.	.021	.016	-.005	
Time to hospital	.555	.636	.081	Signif. 10%
Dummy - migration	.089	.097	.009	
Home asset index	.447	.021	-.426	Signif. 10%
Index of participation in social organizations	.074	-.079	-.152	Signif. 10%
# work animals	.261	.230	-.032	
# wells	.030	.025	-.005	
High yield variety seeds (used) - dummy	.018	.007	-.010	Signif. 10%
Property of the house, registered	.483	.330	-.154	Signif. 10%
Property of the house, not registered	.363	.243	-.120	Signif. 10%
Number of adults	3.187	2.629	-.558	Signif. 10%
Living in rural area	.430	.450	.020	

Table AI-7 shows that the incidence of poverty among attriting families is slightly higher; these differences may not be significant.

Table AI-7. Relationship between poverty and attrition.

(1998) poverty classification	Panel	Attrition
Extreme poor	12%	13%
Poor	26%	28%
Non-poor	62%	59%

In Table AI-8 the incidence of attrition is presented by department, for both rural and urban areas. While attrition is spread out over all departments, both urban and rural, it is not randomly

distributed. In rural areas, Rio San Juan and RAAS have significantly higher levels of attrition (almost 50 percent), and Masaya, Carazo, and Rivas have significantly lower levels. In urban areas, only RAAN has significantly higher levels, and Rivas, Chinandega, and Leon have lower levels.

Table AI-8. Incidence of attrition by department

	ALL					Rural					Urban				
	Panel	Attrition	Total	%	Sig.	Panel	Attrition	Total	%	Sig.	Panel	Attrition	Total	%	Sig.
Nueva Segovia	120	49	169	29	Ref.	48	19	67	28	Ref.	72	30	102	29	Ref.
Jinotega	144	49	193	25		109	34	143	24		35	15	50	30	
Madriz	134	30	164	18	*	89	20	109	18		45	10	55	18	
Esteli	146	56	202	28		62	16	78	21		84	40	124	32	
Chinandega	220	72	292	25		76	38	114	33		144	34	178	19	*
Leon	238	58	296	20	*	98	24	122	20		140	34	174	20	*
Matagalpa	214	77	291	26		142	52	194	27		72	25	97	26	
Boaco	134	45	179	25		93	30	123	24		41	15	56	28	
Managua	388	128	516	25		50	14	64	22		338	114	452	25	
Masaya	232	67	299	22		101	20	121	17	*	131	47	178	26	
Chontales	134	41	175	23		57	21	78	27		77	20	97	21	
Granada	149	41	190	22		56	13	69	19		93	28	121	23	
Carazo	155	38	193	20	*	66	12	78	15	*	89	26	115	23	
Rivas	150	31	181	17	*	91	18	109	17	*	59	13	72	18	*
Rio San Juan	83	57	140	41	*	47	45	92	49	*	36	12	48	25	
RAAN	137	97	234	41	*	84	47	131	36		53	50	103	49	*
RAAS	190	112	302	37	*	77	69	146	47	*	113	43	156	28	
Total	2968	1048	4016	26		1346	492	1838	27		1622	556	2178	26	

In Table AI-9 we separate out the pure migrating households (same dwelling, new household surveyed in 2001, and missing reference to 1998 household in the *carátula* or cover sheet) from the other attriting households. In rural areas, Masaya and Granada have a lower incidence of pure migrating households. In urban areas, migrating households make up over 90 percent of attriting households in RAAN, and 80 percent in Leon. Boaco, Masaya, Granada, Carazo and Rio San Juan all have significantly lower levels of migrating households.

Table AI-9. Among attriting families, incidence of appearing in the *carátula*

	ALL					Rural					Urban				
	In Caratula	Not in Caratula	Total attrition	%	Sig.	In Caratula	Not in Caratula	Total attrition	%	Sig.	In Caratula	Not in Caratula	Total attrition	%	Sig.
Nueva Segovia	19	30	49	61	Ref.	7	12	19	63	Ref.	12	18	30	60	Ref.
Jinotega	11	38	49	78	*	8	26	34	76		3	12	15	80	
Madriz	15	15	30	50		12	8	20	40		3	7	10	70	
Esteli	19	37	56	66		6	10	16	62		13	27	40	67	
Chinandega	19	53	72	74		9	29	38	76		10	24	34	71	
Leon	13	45	58	78	*	6	18	24	75		7	27	34	79	*
Matagalpa	28	49	77	64		16	36	52	69		12	13	25	52	
Boaco	22	23	45	51		12	18	30	60		10	5	15	33	*
Managua	53	75	128	59		6	8	14	57		47	67	114	59	
Masaya	49	18	67	27	*	16	4	20	20	*	33	14	47	30	*
Chontales	20	21	41	51		10	11	21	52		10	10	20	50	
Granada	31	10	41	24	*	11	2	13	15	*	20	8	28	29	*
Carazo	22	16	38	42	*	6	6	12	50		16	10	26	38	*
Rivas	14	17	31	55		9	9	18	50		5	8	13	62	
Rio San Juan	23	34	57	60		15	30	45	67		8	4	12	33	*
RAAN	12	85	97	87	*	8	39	47	83		4	46	50	92	*
RAAS	43	69	112	62		21	48	69	70		22	21	43	49	
Total	413	635	1048	61		178	314	492	64		235	321	556	58	

Multivariate regression – Probit of the probability of attrition

The second step of the analysis is performed in a multivariate framework. We jointly assess the effect of endogenous and exogenous variables on the probability of attrition. We estimate the following Probit equation:

(1) $\Pr(A=1 \ / \ C \ , \ X) = \Phi \ (C, X)$

where A is a dummy variable which assumes value 1 for households which drop out of the sample in 2001, C is household per-capita consumption, the endogenous variable in most of our analyses, X are household characteristics (demographic and socio-economic) and Φ is the cumulative normal distribution. As we do throughout this paper, and which we discuss in Appendix II, we estimate this equation overall as well as by 1998 poverty status and rural/urban location.

Results are reported in Table AI-10. Overall, in this multivariate framework per-capita consumption is not quite significant, which means that the level of consumption is not relevant in explaining the probability of attrition when we control for other exogenous characteristics[9]. It is, however, significant for the rural non poor. That is, the rural non poor with higher levels of consumption are more likely to have dropped out of the survey than the rural non poor with lower levels.

Most of the considerations based on the comparison of the means of the characteristics of the two groups are confirmed in the multivariate framework. Owners of their own house are much less likely to drop out of the sample. This makes sense, if we think that attrition is due to relocation. However, the size of land owned has contradictory impacts. Overall, households with more land in annuals have a higher probability of attrition; by category this is only true for the urban poor. Land in perennials, however, has a negative impact for the rural non poor. Even in a multivariate framework, the value of business assets helps explaining the probability of attrition, always with the unexpected sign: families with more assets are more likely to drop out of the sample. By category, however, this is true only for the urban non poor.

Geographical dummies are highly significant. After controlling for household characteristics, there are still elements of attrition which are unexplained and whose effect is picked up by the location of the household. In particular, families living in the Atlantic region are the most likely to drop out, followed by those living in Managua and in the center of the country. The least likely to drop are households living in the Pacific region. Rural households are less likely to leave the sample. The hypothesis that attrition is linked to surveyor error or laziness is not clear given that both locations with difficult access (Central and Atlantic Regions) and easiest access (Managua) have high levels of attrition. Similarly, given the low probability of Pacific households to drop out, it does not appear that attrition is linked to Hurricane Mitch[10].

All these elements make the interpretation quite difficult and do not indicate a clear pattern, a typology of households which are more likely to abandon the sample. On one side, it seems that smaller households, with a younger head, more members working in poorly paid activities and who do not own the dwelling where they live, are more likely to drop out of the sample. On the other side, however, it is not easy to explain why agricultural assets have conflicting impacts and why business assets are positively correlated with attrition.

Overall, most of the variability is explained by:

- demographic characteristics: gender of the head, size of the household

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[9] This is not due to multicollinearity. Consumption and household characteristics are of course correlated, so that the contemporary inclusion in a multivariate framework could increase the standard error of the regression, making the efficiency of the estimators drop. We ran the same regression including consumption as the only explanatory variable, then excluding consumption and including all the other household characteristics X. The results are consistent with the ones presented here.

[10] Further, a follow up survey was conducted on 1998 LSMS informants affected by Hurricane Mitch, so presumably their location was known for the planning of the 2001 sample.

- ownership of the house, with families which hold property rights on the dwelling having a probability of attrition lower by over 20 percent. This impact is least important for the rural poor (13 percent), and most important for the urban non poor (25 percent)
- regional factors, with attrition least likely in the Pacific region. With respect to this area, the probability of attrition increases by about 7-9 percent in the Central region and in Managua, and by over 20 percent in the Atlantic region.

Table AI-10. Probit of the probability of attrition conditional on household characteristics in 1998 (dprobit – coefficients represent marginal effects).

	All	Rural Poor	Rural Non-Poor	Urban Poor	Urban Non-Poor
Consumption	.000	-.000	.000***	-.000	.000
	(1.57)	(.86)	(3.61)	(.25)	(.14)
Atlantic region	.232***	.262***	.220***	.134**	.172***
	(9.03)	(5.41)	(3.41)	(2.23)	(4.03)
Central region	.072***	-.005	.147***	.075	.087***
	(3.78)	(.15)	(3.11)	(1.50)	(2.71)
Managua	.089***	-.024	.131	.107	.098***
	(3.26)	(.20)	(1.60)	(1.29)	(2.95)
Share of adults, agricultural wage	.087***	.153***	.069	.091	.006
	(2.90)	(3.35)	(1.00)	(1.25)	(.06)
Share of adults, non agricultural wage	-.014	.014	.095	-.004	-.054
	(.57)	(.21)	(1.52)	(.09)	(1.37)
Share of adults, non agricultural self employed	.011	-.112	-.041	.052	.036
	(.35)	(1.21)	(.54)	(.65)	(.82)
Share of adults, agricultural self employed	-.019	-.109	.001	-.113	.081
	(.49)	(1.45)	(.01)	(.94)	(1.19)
Hh average years of education	-.000	-.013	-.000	.010	-.001
	(.09)	(1.63)	(.04)	(1.13)	(.33)
Technical assistance exists	-.040	-.025		-.008	-.070
	(1.36)	(.57)		(.08)	(.99)
Received pension	.037			.003	.034
	(.90)			(.03)	(.68)
Credit constraint	.003	.002	.005	.035	-.022
	(.21)	(.07)	(.14)	(.89)	(.84)
Paved access to home	.004	-.052	.045	-.010	.009
	(.17)	(.91)	(.67)	(.17)	(.33)
Cattle [n. of cows]	.001	.002	.001		.000
	(1.62)	(.84)	(1.43)		(.08)
Land in annuals	.000**	.000	.000	.004**	.000
	(2.13)	(.85)	(1.05)	(2.44)	(.59)
Land in perennials	-.001	.011	-.011**		
	(.99)	(1.59)	(2.12)		
Value of assets for non agricultural business	.000*	.000	.000	.000	.000**
	(1.80)	(.52)	(.10)	(.62)	(2.05)
Member of agricultural organization	.045	.000	.023		
	(.82)	(.00)	(.28)		
Migration assets	.022	.049	-.017	.001	.026
	(.85)	(1.08)	(.27)	(.02)	(.54)
Home asset index	-.008*	-.003	-.042***	-.041*	-.003
	(1.65)	(.12)	(2.74)	(1.84)	(.55)
Dirt floor	.013	.024	-.001	-.037	.037
	(.76)	(.72)	(.03)	(.82)	(1.17)
Family size	-.016***	-.022***	-.004	-.021***	-.019***
	(5.31)	(3.94)	(.54)	(2.73)	(3.10)
Dependency ratio	.059*	.101	.099	-.017	.041
	(1.76)	(1.41)	(1.41)	(.17)	(.82)
Female headed household	-.030*	-.048	.021	-.065	-.031
	(1.71)	(1.30)	(.42)	(1.49)	(1.21)
Head of household age	-.001**	-.001	-.001	-.001	-.002*
	(2.35)	(1.29)	(.73)	(1.00)	(1.85)
Head speaks indigenous language	-.056				
	(1.25)				
# chemical applicators	-.042**	-.036			
	(2.00)	(1.12)			
dummy - well	.099**	.089	.233***		
	(2.08)	(1.24)	(2.73)		

HYV seeds	-.116*	-.022	-.131		
	(1.91)	(.20)	(1.54)		
Property of house, registered	-.202***	-.114***	-.251***	-.204***	-.264***
	(1.40)	(3.10)	(5.47)	(3.69)	(8.42)
Property of house, not registered	-.201***	-.164***	-.190***	-.183***	-.238***
	(1.97)	(4.75)	(4.77)	(3.53)	(8.25)
R-squared	.09	.12	.19	.09	.10
Observations	3670	1107	593	557	1413

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Comparison of WLS and OLS

We follow Fitzgerald et al. (1998a and 199b) and perform the FGM test based on the comparison of the coefficients of the OLS and WLS regressions. In fact, WLS estimation is able to correct attrition bias when attrition depends on observable characteristics, hence this problem can be excluded if OLS and WLS coefficients are similar. Weights for WLS regression are (normalized) inverse selection probabilities, calculated as follows:

$$(1) \qquad w = [Pr(A=0 \, / \, X)] \, / \, [Pr(A=0 \, / \, X, \, Z)] = \Phi \, (X)/\Phi \, (X,Z)$$

in which Z is a set of selection variables, which influence the probability of attrition but not the level of the dependent variable of interest. We compare WLS and OLS coefficients through the Hausman test. Here we present the results relative to rural poor households (table AI-11).

Table AI-11. Hausman test of difference between WLS and OLS estimates

	(b) WLS Prior	(B) OLS Current
Atlantic region	.000	-.013
Central region	-.134	-.136
Managua	-.045	-.071
Share of adults, agricultural wage	-.010	-.017
Share of adults, non agricultural wage	.190	.197
Share of adults, non agricultural self employed	.232	.245
Share of adults, agricultural self employed	-.289	-.285
Hh average years of education	.056	.056
Technical assistance exists	-.045	-.048
Credit constraint	-.016	-.013
Paved access to home	.074	.070
Cattle [n. of cows]	.014	.015
Land in annuals	.001	.001
Land in perennials	-.008	-.011
Value of assets for non agricultural business	.000	.000
Member of agricultural organization	-.118	-.125
Migration assets	.023	.014
Home asset index	.090	.089
Dirt floor	-.058	-.067
Family size	-.043	-.043
Dependency ratio	-.182	-.186
Female headed household	-.032	-.029
Head of household age	.003	.003
# chemical applicators	.078	.077
dummy - well	.077	.073
HYV seeds	-.105	-.106

b = less efficient estimates obtained previously from regress (WLS)
B = fully efficient estimates obtained from regress (OLS)

Test: Ho: difference in coefficients not systematic
        $\text{chi2}(25) = (b-B)'[(V\_b-V\_B)^{(-1)}](b-B)$
              =   1.54
          Prob>chi2 =   1.000

In no case the hypothesis of no systematic difference between WLS and OLS estimates is rejected, meaning that attrition does not seem to be a problem for any of the four groups that we analyze.

Heckman procedure

The fourth step of the analysis of attrition assesses the dependence of the dynamic of consumption on the probability of attrition. This procedure consists in the joint estimation of the probability of attrition and the consumption equation. The resulting model would then be:

(2a) $\log\_C(i, 01) = \alpha + \beta * X(i, 98) + \varepsilon(i)$ regression equation

with C(i, 01) observed only if

(2b) $A^* = \zeta + \theta * X(i, 98) + \pi * Z(i, 98) + \eta(i) > 0$ selection equation

where:

$$\varepsilon \sim N(0, \sigma)$$
$$\eta \sim N(0, 1)$$
$$corr(\varepsilon, \eta) = \rho$$

where 98 and 01 refer to the year, α β ζ θ π are parameters to be estimated and ε and η are disturbances. Each household is observed in both periods if the latent variable A*, not observed, is positive. We only observe the dummy variable A, which assumes the value of one when the family is part of the panel in both periods.

The estimation can be carried out following the Heckman[11] procedure for the correction of selection bias (Fitzgerald, et al, 1998a and 1998b). Attrition is predicted on the base household characteristics X, which also explain consumption, and on Z, a set of selection variables including other exogenous variables which are excluded from the model for consumption. When $\rho \neq 0$, standard regression techniques applied to the first equation (2a) yield biased results. Heckman provides consistent, asymptotically efficient estimates for all the parameters in such models. When we cannot reject the null hypothesis of independence of the two equations (2a) and (2b), standard regressions techniques can be applied to equation (2a).

We present here the results relative to rural poor households. The null hypothesis of independence between the consumption equation and the selection equation cannot be rejected. The same result is obtained for the other groups, with the only exception of non poor urban households.

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[11] Heckman (1979).

Table AI-12. Heckman test – independence of consumption and selection equations

	Main regression		Selection equation	
	Coef.	P>|z|	Coef.	P>|z|
Atlantic region	-.070	.387	-.742	-5.240
Central region	-.132	.004	.023	.200
Managua	-.065	.650	.060	.160
Share of adults, agricultural wage	-.061	.415	-.466	-3.230
Share of adults, non agricultural wage	.199	.021	-.024	-.120
Share of adults, non agricultural self employed	.270	.015	.365	1.330
Share of adults, agricultural self employed	-.249	.023	.318	1.400
Hh average years of education	.059	.000	.039	1.540
Technical assistance exists	-.043	.420	.074	.550
Credit constraint	-.013	.719	-.007	-.080
Paved access to home	.083	.252	.143	.750
Cattle [n. of cows]	.014	.000	-.005	-.640
Land in annuals	.001	.136	-.001	-.600
Land in perennials	-.014	.389	-.034	-1.200
Value of assets for non agricultural business	.000	.852	.000	-.380
Member of agricultural organization	-.121	.225	-.027	-.100
Migration assets	.003	.964	-.158	-1.160
Home asset index	.091	.006	.017	.200
Dirt floor	-.074	.129	-.082	-.740
Family size	-.038	.000	.065	4.070
Dependency ratio	-.218	.029	-.324	-1.470
Female headed household	-.017	.730	.131	1.080
Head of household age	.003	.027	.004	1.260
# chemical applicators	.083	.023	.129	1.150
dummy - well	.058	.552	-.250	-1.120
HYV seeds	-.098	.461	.070	.200
Constant	8.242	.000	-.020	-.070
House property, registered			.353	2.970
House property, not registered			.543	4.960
athrho	.342	.256		
lnsigma	-.674	.000		
rho	.329			
sigma	.510			
lambda	.168			
LR test of indep. eqns. (rho = 0): chi2(1) = 1.51 Prob > chi2 = 0.2184				

Results indicate that attrition is not a major problem in our sample. Multivariate Probit analysis shows that household characteristics are able to explain only a modest part of the variability in the probability of attrition. Furthermore, Heckman and FGM tests reject the hypothesis that attrition introduces a bias in our analysis. As mentioned above, the only exception is represented by Heckman test for urban non poor households, according to which the null hypothesis of independence of consumption and selection equation is rejected at 10% level of confidence (though it is not if the level is set at 5%). As our focus is on poor households, in particular in rural areas, we ignore this problem in this version of the paper. We feel confident in proceeding by using standard regression techniques.

APPENDIX II. ECONOMETRIC ANALYSIS OF CONSUMPTION AND INCOME

Analyzing consumption

Our principal indicator for household well being in this study is per capita household consumption. While our main message involves gauging the determinates of exiting poverty, we will not analyze exiting poverty per se, but rather increases in consumption. When poverty is the main focus, households are classified according to the condition of extreme poverty, moderate poverty or non-poverty. Probit analyses of poverty status are performed in order to find out which household characteristics are associated with the probability of living in poverty. In this type of analysis, however, only part of available information is used. All the poor are considered homogeneously (with a 1), as with the non-poor (with a 0). Even when measures of intensity of poverty are considered, such as the distance from the poverty line or the square of this distance, information on the non-poor is lost. Further, the analysis is dependent on the choice of the poverty line, which implies a certain degree of arbitrariness.

As the definition of poverty depends on the level of per-capita household consumption, full information is used when the dynamic of consumption is studied. In this case, the different effect of changes in demographic or socio-economic characteristics for the poor versus the rich can be recovered either by performing regressions differentiated by quintiles of the consumption distribution or by allowing the coefficients to vary for poor and non-poor.

In this paper, we are interested in the dynamic of consumption between 1998 and 2001, which determines the evolution of poverty. Households can increase consumption and exit poverty by allocating time to different labor activities. Henceforth, our poverty exit path variables are the allocation of household labor to the following economic activities:

- off farm agricultural wage employment;
- non agricultural wage employment;
- on farm agricultural and livestock self employment;
- non agricultural self employment.

These categorizations are not ideal; the wage labor categories in particular are too broad and heterogeneous, which is especially relevant for the urban analysis. We should also separate agricultural from livestock employment, but the data do not allow this differentiation.

We then consider five policies, with which the government can support consumption or increase physical capital, with effects in the short or medium term:

- agricultural technical assistance;
- pensions;
- credit (removal of credit constraints);
- infrastructure (roads).
- facilitate access to assets (education, land, cattle, non agricultural business, etc)

Policies affect consumption through a change in income from working activities and through preferences. If our classification of labor was refined and more precise, the coefficient on the policy variables would retain only the meaning related to the latter effect. The former would be captured by the path variables, when these are included in the analysis. A higher level of education, for

example, would allow a shift towards more qualified activities. The problem could be analyzed in the context of a system of simultaneous equations, with the paths out of poverty explaining the change in consumption, and the policies (and household characteristics and assets) as explaining labor activities (the paths). However, both the literature and our results tell us that education, infrastructure and other policy variables do have a direct effect on consumption. This may be due to the effect of the preferences, but probably also to the imperfect nature of our labor variables (in which, for example, skilled and unskilled non agricultural wage labor are pulled together). The refinement of labor strategies into more homogeneous categories deserves further research, in order to find out which activities, within each group, constitute paths out of poverty. At the present stage, we include paths, policies and other household characteristics in the same equation.

Household characteristics we control for include:

- family size and dependency ratio
- age, ethnicity, and gender of the head of the household
- participation in producer organizations
- housing characteristics
- regional dummies
- agricultural technology level

Assets include:

- land
- livestock (heads of cattle)
- non agricultural business inventory (valued in 1998 Córdobas)
- historical migration
- level of adult education
- wealth index (based on consumer durables)

Not all the variables can always be included in the regression, for two reasons. First, sometimes a variable has too few values different from zero, so that, if included, it would end up picking up the individual effect of the families with a non null value and not the impact of the variable on a generic household. Second, sometimes problems of multicollinearity exist. The contemporaneous inclusion of highly correlated variables would inflate the standard error of the regression, reducing the significance of our estimates. For these two reasons, some variables are dropped from the regressions that we present.

The ideal system would be to regress the change in consumption between 1998 and 2001 on poverty exit strategies, policies and household characteristics. Of all these variables we would consider both initial values and variations, in order to allow for non linear returns, particularly decreasing returns for greater initial levels of assets. Otherwise the results would be difficult to interpret. Hence, our ideal equation to estimate would be:

(1)
$$
\begin{aligned}
C(i, 01) - C(i, 98) = \alpha\ &+ \\
\beta_1 PATH(i, 98)\ &+ \gamma_1[PATH\,(i, 01) - PATH\,(i, 98)]\ + \\
\beta_2 POLICY(i, 98)\ &+ \gamma_2[POLICY\,(i, 01) - POLICY\,(i, 98)]\ + \\
\beta_3 CHAR(i, 98)\ &+ \gamma_3[CHAR\,(i, 01) - CHAR\,(i, 98)]\ + \\
\beta_4 ASSETS(i, 98)\ &+ \gamma_4[ASSETS\,(i, 01) - ASSETS\,(i, 98)]\ + \\
\varepsilon\,(i)
\end{aligned}
$$

estimated separately by poverty and rural/urban status.[12]

Model specification problems with this approach may be difficult to surmount, with two potential sources of bias. First, many if not most of the explanatory variables are determined simultaneously with consumption. Consumption poverty may influence household decisions on household size or composition, allocation of household labor, land transactions or livestock holdings, for example. Bias in the respective coefficients would result. Clearly for some variables this potential bias is greater then others, and we can possibly reconstruct some variables to minimize this bias.

Second, policy variables representing specific programs (whether government or NGO, such as technical assistance and provision of public works) may suffer from different types of selection bias. The programs may be directed towards households (or communities) of a certain type thus under or over estimating the specific impact of the program on welfare. Typical solutions to this kind of econometric problem include instrumental variables and matching techniques. However, as no specific program predominates, we have not pursued this option.[13]

Given the above complications, we postpone the consideration of the above model to a later version of the paper. For the time being, we use a more simple specification and estimate:

$$(2) \quad \log\_C(i, 01) = \alpha + \beta_1 \, PATH(i, 98) + \beta_2 \, POLICY(i, 98) + \beta_3 \, CHAR(i, 98) + \beta_4 \, ASSETS(i, 98) + \varepsilon(i)$$

which provides insight into the role of paths, policy variables, household characteristics and assets on 2001 welfare levels. A semi-logarithmic specification is chosen in order to guarantee normality. Equation (2) is estimated using two different procedures. First, we use OLS, estimating separate equations by poverty and rural/urban status. Second, we estimate quintile regressions, which allow variation of coefficients across the income distribution, by rural/urban status. These specifications are based on our hypothesis that coefficients differ across these criteria.[14] While the rural/urban differentiation is standard in the consumption equation literature, we include poverty status as well in order to highlight our message in terms of the determinants of exit strategies from poverty.

Analyzing consumption through income

In the previous section, we explained why we focus on consumption in order to analyze the dynamic of poverty. Consumption is the most accepted indicator in statistical surveys for household well being, and is often preferred over income as it is less prone to short term variation. Income is used to purchase consumption, but households have many strategies to smooth consumption in the face of income variations. Consumption analysis allows assessing the contribution of household assets and characteristics and other explanatory variables to overall well being, but household assets and characteristics affect consumption through the mediation of income. Utilizing data on income by source allows us to characterize the role of assets and characteristics on the basis of household livelihood strategies.

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[12] This is similar to the equation estimated in Grootaert, Kanbur, and Oh (1995)
[13] See Davis and Murgai (2000) for an attempt to do such an analysis on technical assistance using the 1998 data.
[14] The appropriateness of this model compared to that which assumes the same coefficients for the two groups, can be tested using a F test.

The basis of a livelihood strategy is the asset position of the household at a given point in time[15]. Household assets are stocks, which may depreciate over time or may be expanded through investment. Based on access to a particular set of assets for a given period, the household must decide which activities it will employ to produce income and the intensity of involvement in that activity. Each activity may involve the use of one or more assets. Agricultural production, for example, may use natural capital in the form of land and water, human capital, and physical capital. The decision on the set of activities a household will employ and the intensity of those activities is conditioned on the context in which the household operates, such as natural forces, markets and institutions.

Conceptually, the mapping of assets to income through activities can be viewed as similar to a production process, with assets corresponding to factors of production and income as the output of the process (Barrett and Reardon, 2000). The return to assets depends on the parameters of the functions, which are determined by prices of inputs and outputs as well as other characteristics of the context. The allocation of assets to each activity is expected to maximize household income subject to a number of constraints. Households will allocate assets in a manner that equates the marginal value product across activities or will allocate assets entirely to one activity that has a superior return.

One of the key features of this approach is that households simultaneously determine the allocation of assets to different activities. Researchers focusing on a single activity may find that investment in infrastructure reduces income from that activity, which may lead to perverse policy implications. Households may reap the rewards from schooling through abandoning or limiting one activity in favour of another. A low or negative return to schooling in crop production, for example, may mean that the more educated have shifted to other activities such as non-farm employment. It does not mean, however, that education reduces the returns to agriculture.

The household's decision on the allocation of assets across activities is censored since households do not necessarily participate in all possible activities. This requires a simultaneous equation model in which the dependent income variables are censored by unobservable latent variables influencing the activity participation decision. Following Taylor and Yunez-Naude (2000) and Winters, Davis, and Corral (2002), we control for endogeneity of activity choices and use Lee's generalization of Amemiya's two step estimator in a simultaneous equation model.

Under this framework the effect of policies and household assets and characteristics on different activities can be assessed. Currently available data allows us to look at income from agricultural wage labor, non agricultural wage labor, agricultural and livestock business, and non agricultural business. These activities represent alternative paths which a household can choose in order to progress in economic terms.

In the first stage a Probit regression is estimated for participation in each kind of activity and the corresponding Inverse Mill's Ratio (IMR) is determined. This variable is then introduced in the system of simultaneous equations in order to control for the endogeneity of the choice. While ideally we would like to look at the determinants of the change in income, we run into similar specification problems as described above with consumption, and thus we analyze total income in 2001.

$$
\begin{aligned}
(3) \quad \log\_AWI(i, 01) &= \alpha + \beta\, X(i, 98) + AW\_IMR(i) + AW\varepsilon(i) \\
\log\_NAWI(i, 01) &= \alpha + \beta\, X(i, 98) + NAW\_IMR(i) + NAW\varepsilon(i) \\
\log\_ASI(i, 01) &= \alpha + \beta\, X(i, 98) + AS\_IMR(i) + AS\varepsilon(i) \\
\log\_NASI(i, 01) &= \alpha + \beta\, X(i, 98) + NAS\_IMR(i) + NAS\varepsilon(i)
\end{aligned}
$$

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[15] This discussion follows Winters, Davis, and Corral (2002).

where AWI is agricultural wage income, NAWI is non agricultural wage income, ASI is agricultural business income, NASI is non agricultural business income and IMR refers to the respective Inverse Mill's Ratios. Once again, the logarithm of dependent variables is considered in order to guarantee normality. As earlier, this system is estimated separately by urban and rural households, and poor and non poor. Full results are found below.

Results

Table AII-1. Summary, consumption equation results

	Poor				Non poor			
	Rural		Urban		Rural		Urban	
	C level	C quant.	C level	C quant.	C level	C quant.	C level	C quant.
PATHS - LABOR								
Share of adults, agricultural wage			-	-			-	-
Share of adults, non agricultural wage	+							-
Share of adults, non agricultural self employed	+	+	-			+		
Share of adults, agricultural self employed	-	-	-				+	
POLICIES								
Hh average years of education	+	+	+	+	+	+	+	+
Technical assistance exists								
Pension								
Credit constraint		+			+			+
Paved access to home			+				+	+
ASSETS								
Cattle [n. of cows]	+	+			+	+	+	+
Land in annuals						+		
Land in perennials					+			
Adjusted size of agricultural land								+
Value of assets for non agricultural business			+	+	+		+	+
Member of agricultural organization	-							
Migration assets				-				
Home asset index	+	+	+	+	+	+	+	+
Dirt floor			-	-			-	
# chemical applicators	+							
dummy - well								
HYV seeds								
DEMOGRAPHIC								
Family size	-	-	-	-	-	-	-	-
Dependency ratio	-	-	-	-		-	-	-
Female headed household				-				-
Head of household age	+				+	+	+	
REGION								
Atlantic region							+	+
Central region	-	-				-	+	
Managua			+	+			+	+

+ or – indicates the sign of the significant (at 10 percent) variables
C level = 2001 level of logarithm of consumption, robust OLS
C quant. = 2001 level of logarithm of consumption, quantile regression

Table AII-2. Consumption level (log) - Robust OLS

	Rural Poor	Rural Non-Poor	Urban Poor	Urban Non-Poor
Atlantic region	-.013	-.081	.017	.156***
	(.20)	(1.07)	(.24)	(2.96)
Central region	-.136***	-.096	-.034	.069*
	(2.99)	(1.60)	(.56)	(1.87)
Managua	-.071	-.030	.239***	.142***
	(.54)	(.36)	(2.65)	(3.79)
Share of adults, agricultural wage	-.017	-.077	-.276***	-.363***
	(.26)	(.84)	(2.71)	(3.62)
Share of adults, non agricultural wage	.197**	-.012	-.076	-.047
	(2.26)	(.12)	(1.11)	(.95)
Share of adults, non agricultural self employed	.245**	.123	-.270**	-.063
	(2.14)	(.99)	(2.52)	(1.05)
Share of adults, agricultural self employed	-.285***	-.011	-.322**	.166*
	(2.66)	(.10)	(2.09)	(1.75)
Hh average years of education	.056***	.040***	.047***	.047***
	(5.85)	(4.10)	(4.45)	(8.01)
Technical assistance exists	-.048		-.087	-.044
	(.92)		(.75)	(.55)
Credit constraint	-.013	-.085*	-.033	-.027
	(.36)	(1.66)	(.67)	(.81)
Paved access to home	.070	.031	.113*	.117***
	(.98)	(.42)	(1.75)	(3.64)
Cattle [n. of cows]	.015***	.006***		.003***
	(3.47)	(4.92)		(3.63)
Land in annuals	.001	-.001	.002	.000
	(1.58)	(.89)	(.68)	(.13)
Land in perennials	-.011	.001**		
	(.50)	(2.20)		
Value of assets for non agricultural business	-.000	.000**	.000***	.000***
	(.31)	(2.44)	(3.40)	(3.17)
Member of agricultural organization	-.125*	-.068		
	(1.67)	(.71)		
Migration assets	.014	-.093	-.030	-.013
	(.25)	(1.09)	(.33)	(.18)
Home asset index	.089***	.100***	.064***	.081***
	(3.03)	(5.96)	(3.36)	(1.67)
Dirt floor	-.067	.034	-.111*	-.129***
	(1.47)	(.67)	(1.93)	(3.47)
Family size	-.043***	-.053***	-.043***	-.076***
	(6.74)	(5.56)	(4.48)	(11.15)
Dependency ratio	-.186*	-.057	-.301**	-.128**
	(1.85)	(.55)	(2.06)	(1.97)
Female headed household	-.029	-.049	.055	-.002
	(.62)	(.75)	(1.02)	(.08)
Head of household age	.003*	.003*	.002	.005***
	(1.76)	(1.75)	(1.02)	(4.78)
# chemical applicators	.077**			
	(2.36)			
dummy - well	.073	-.024		
	(.84)	(.21)		
HYV seeds	-.106	.149		
	(1.01)	(1.17)		
Pension			-.131	-.090
			(1.29)	(1.41)
Constant	8.347***	8.706***	8.592***	8.687***
	(61.69)	(67.01)	(53.52)	(97.13)
N. observations	794	450	408	1070
R-squared	.24	.30	.31	.47

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table AII-3. Quantile regression on level of consumption (log)

	Rural		Urban	
	30%	70%	30%	70%
Atlantic region	-.009	-.015	.000	.145**
	(.13)	(.22)	(.01)	(2.03)
Central region	-.215***	-.078	-.007	.048
	(4.16)	(1.48)	(.20)	(1.03)
Managua	.041	.015	.120***	.165***
	(.40)	(.29)	(3.54)	(6.34)
Share of adults, agricultural wage	-.082	-.070	-.264**	-.422***
	(1.20)	(1.03)	(2.55)	(5.30)
Share of adults, non agricultural wage	.077	.154	.002	-.082**
	(.75)	(1.50)	(.03)	(2.07)
Share of adults, non agricultural self employed	.266**	.295***	.028	-.079
	(2.21)	(3.32)	(.39)	(1.37)
Share of adults, agricultural self employed	-.197*	-.175	.047	.009
	(1.74)	(1.38)	(.42)	(.12)
Hh average years of education	.063***	.043***	.050***	.050***
	(4.84)	(4.27)	(8.06)	(7.64)
Credit constraint	-.126***	-.023	-.053	-.085*
	(3.67)	(.62)	(1.31)	(1.77)
Paved access to home	-.001	.088	.057	.065
	(.02)	(1.29)	(.97)	(1.21)
Cattle [n. of cows]	.007*	.009***		
	(1.92)	(5.22)		
Land in annuals	.001	.001**		
	(.95)	(2.43)		
Land in perennials	.002	.001		
	(.20)	(.08)		
Total land size - adjusted			.001	.001**
			(1.33)	(2.42)
Value of assets for non agricultural business	.000	.000	.000*	.000**
	(1.54)	(1.36)	(1.65)	(2.40)
Member of agricultural organization	-.081	-.119		
	(.76)	(1.43)		
Migration assets	.014	-.031	-.116**	.002
	(.23)	(.70)	(2.18)	(.03)
Home asset index	.111***	.096***	.084***	.090***
	(5.44)	(3.53)	(8.72)	(11.11)
Family size	-.055***	-.067***	-.193***	-.116***
	(9.14)	(12.67)	(6.38)	(3.15)
Dependency ratio	-.244***	-.294***	-.068***	-.072***
	(3.14)	(3.14)	(1.44)	(15.35)
Female headed household	-.052	-.055	-.214***	-.186**
	(1.02)	(.97)	(2.97)	(2.23)
Head of household age	.002	.006***	-.031	.005
	(1.01)	(3.48)	(.88)	(.14)
Head of household speaks indigenous lang.	.150	.029	.004***	.005***
	(1.44)	(.40)	(3.02)	(4.88)
Constant	8.351***	8.723***	8.478***	8.863***
	(46.55)	(67.42)	(93.33)	(72.29)
N. observations	1268		1478	
R-squared	.23	.23	.35	.35

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table AII-4. Income system, rural poor

	Participation – Probit				Level of income (log)			
	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self
Atlantic region	-.427**	-.454**	-.195	.463**	.066	-.190	.055	.666*
	(2.51)	(2.47)	(1.01)	(2.13)	(.12)	(.45)	(.17)	(1.82)
Central region	.010	-.189	-.352**	.041	.127	-.256	.043	.186
	(.09)	(1.55)	(2.58)	(.33)	(.46)	(.96)	(.17)	(.81)
Managua	-.025	-.462	-.358	.233	.300	.028	.092	-.403
	(.07)	(1.02)	(.88)	(.61)	(.33)	(.03)	(.13)	(.55)
Share of adults, agricultural wage	.844***	-.190	.007	-.288	.745			
	(4.45)	(1.04)	(.04)	(1.58)	(1.03)			
Share of adults, non-ag. wage	-.764***	1.637***	.335	-.431*	-.104	2.129**		
	(3.14)	(6.39)	(1.33)	(1.82)	(.13)	(2.48)		
Share of adults, non-ag. self-emp.	-.396	-.542	2.613***	.068			2.091**	
	(1.32)	(1.63)	(6.37)	(.24)			(2.18)	
Share of adults, ag. self-emp.	.054	-.714**	-.552*	.883***				-.034
	(.19)	(2.42)	(1.75)	(2.93)				(.05)
Hh average years of education	-.055**	.062**	.021	-.040	-.001	.085	.000	.049
	(2.10)	(2.31)	(.71)	(1.39)	(.01)	(1.29)	(.01)	(.92)
Technical assistance exists	.109	.126	.065	-.151				.037
	(.81)	(.87)	(.41)	(.98)				(.14)
Credit constraint	.090	-.092	-.068	-.046	-.043	-.102	.066	-.183
	(.92)	(.88)	(.60)	(.43)	(.18)	(.47)	(.36)	(.95)
Paved access to home	.054	.025	.263	-.327*			.195	.214
	(.30)	(.14)	(1.22)	(1.72)			(.55)	(.53)
Cattle [n. of cows]	-.012	-.017	-.003	.105***	.005	-.004	.006	.053**
	(.93)	(1.29)	(.26)	(3.32)	(.17)	(.15)	(.31)	(2.28)
Land in annuals	-.001	-.002**	.001	-.001	.001	-.001	.002	.002
	(1.05)	(2.00)	(1.19)	(.45)	(.26)	(.17)	(.70)	(.69)
Land in perennials	-.001	-.048	-.634	.040	.122	-.032	1.207***	-.038
	(.03)	(.65)	(1.33)	(.65)	(.80)	(.22)	(3.91)	(.31)
Value of assets for non-ag. business	.000***	-.000	.000	.000	.000	-.000	.000	.000
	(2.88)	(.35)	(.63)	(.82)	(.64)	(.16)	(.50)	(.44)
Member of agricultural organization	-.498*	-.145	.801***	-.396				2.985***
	(1.94)	(.56)	(3.06)	(1.37)				(3.33)
Migration assets	.157	.089	-.134	.050			-.017	-.056
	(1.01)	(.53)	(.76)	(.29)			(.06)	(.20)
Home asset index	-.185**	.007	.140	-.064	.081	.109	.139	-.289*
	(1.97)	(.07)	(1.57)	(.67)	(.31)	(.59)	(.81)	(1.72)
Dirt floor	.244*	-.180	.046	-.221	-.095	-.090	-.012	.072
	(1.90)	(1.33)	(.32)	(1.48)	(.26)	(.31)	(.05)	(.28)
Family size	.025	.066***	.013	.055***	-.031	-.002	-.033	-.057
	(1.54)	(3.65)	(.66)	(2.73)	(.69)	(.05)	(1.02)	(1.39)
Dependency ratio	-.652***	-.517*	.290	-.429	-.519	-.080	.185	-.270
	(2.59)	(1.77)	(1.00)	(1.61)	(.62)	(.13)	(.39)	(.52)
Female headed household	.082	-.029	.285**	-.025	.156	-.086	-.096	-.115
	(.67)	(.22)	(2.03)	(.19)	(.52)	(.32)	(.38)	(.48)
Head of household age	-.001	-.007*	-.005	-.002	.002	.003	.001	.006
	(.20)	(1.94)	(1.31)	(.57)	(.24)	(.46)	(.10)	(.95)
# chemical applicators	.002	-.131	-.009	.009				.216
	(.02)	(1.15)	(.08)	(.09)				(1.20)
dummy - well	.095	-.246	.268	-.079				.369
	(.36)	(.91)	(1.01)	(.27)				(.77)
HYV seeds	.426	.010	.053	.252				-.525
	(1.13)	(.03)	(.13)	(.56)				(.79)
IMR					-3.228***	-2.328***	-2.297***	-5.313***
					(-2.73)	(3.43)	(4.68)	(5.25)
Constant	-.418	-.077	-.719*	.665*	6.314***	4.922***	4.949***	6.239***
	(1.21)	(.21)	(1.91)	(1.77)	(4.25)	(4.85)	(5.40)	(7.39)
R-squared	.11	.18	.20	.11	.15	.25	.24	.24
Observations	794	794	794	794	793	793	793	793

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table AII-5. Income system, rural non poor

	Participation – Probit				Level of income (log)			
	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self
Atlantic region	.058	-.153	-.522**	-.164	-.131	-.108	.149	.378
	(.25)	(.63)	(2.07)	(.70)	(.29)	(.20)	(.25)	(.76)
Central region	.341*	-.508***	-.423**	-.002	-.010	-.115	.150	.391
	(1.92)	(2.93)	(2.43)	(.01)	(.03)	(.28)	(.35)	(1.13)
Managua	.142	.163	.122	-.230	-.248	-.234	.488	.062
	(.42)	(.54)	(.45)	(.87)	(.48)	(.39)	(.81)	(.11)
Share of adults, agricultural wage	2.241***	-.197	.278	-.557**	1.853**			
	(6.67)	(.67)	(.96)	(2.01)	(2.00)			
Share of adults, non-ag. wage	.346	1.535***	.094	-.134	-.229	1.624*		
	(1.20)	(4.86)	(.34)	(.52)	(.44)	(1.89)		
Share of adults, non-ag. self-emp.	.019	-.472*	2.319***	-.152			2.332**	
	(.06)	(1.71)	(6.49)	(.53)			(2.01)	
Share of adults, ag. self-emp.	.098	-.719**	-.646*	.335				1.071
	(.28)	(2.05)	(1.84)	(1.13)				(1.61)
Hh average years of education	-.027	.105***	-.005	-.045	.031	.147*	-.023	-.055
	(.91)	(3.64)	(.19)	(1.62)	(.53)	(1.81)	(.38)	(.89)
Credit constraint	.442***	.078	.294*	.223	-.025	.148	.007	.040
	(2.89)	(.52)	(1.91)	(1.54)	(.08)	(.45)	(.02)	(.12)
Paved access to home	-.015	.351	-.145	.298			-.301	.596
	(.06)	(1.46)	(.58)	(1.18)			(.59)	(1.15)
Cattle [n. of cows]	-.003	-.005	-.002	.001	.004	-.006	.005	.029***
	(.50)	(1.07)	(.29)	(.11)	(.39)	(.62)	(.49)	(2.89)
Land in annuals	-.004	-.010**	-.004	.006*	.004	.014*	.001	.008*
	(1.05)	(2.46)	(1.21)	(1.71)	(.70)	(1.80)	(.23)	(1.65)
Land in perennials	-.002	.000	.004*	.025	.001	.001	.004	.002
	(1.05)	(.18)	(1.81)	(.89)	(.20)	(.14)	(.61)	(.40)
Value of assets for non-ag. business	-.000	.000	.000	-.000***	.000	.000	.000**	-.000
	(1.26)	(1.35)	(1.33)	(2.90)	(1.40)	(.58)	(1.99)	(1.42)
Member of agricultural organization	-.626	.683**	.298	-.231				.650
	(1.52)	(2.09)	(.96)	(.76)				(.74)
Migration assets	-.306	.024	-.326	.274			-.059	.115
	(1.24)	(.09)	(1.27)	(1.05)			(.11)	(.23)
Home asset index	-.086	-.053	.071	-.192***	.070	.071	.141	-.434***
	(1.35)	(1.10)	(1.42)	(3.25)	(.67)	(.63)	(1.18)	(3.04)
Dirt floor	.258	.130	-.259*	-.143	.004	.012	.015	-.280
	(1.58)	(.83)	(1.70)	(.96)	(.01)	(.03)	(.04)	(.87)
Family size	.073**	.086***	.070**	.125***	-.077	-.032	-.013	.135
	(2.25)	(2.84)	(2.29)	(3.74)	(1.17)	(.38)	(.16)	(1.59)
Dependency ratio	-.559*	-.118	.182	-.476*	.074	-.058	-.039	-1.046
	(1.77)	(.39)	(.60)	(1.66)	(.12)	(.09)	(.06)	(1.63)
Female headed household	-.392*	-.039	.398**	-.451**	.109	-.049	.000	-.644
	(1.73)	(.19)	(2.03)	(2.40)	(.26)	(.12)	(.00)	(1.37)
Head of household age	.003	.009*	-.001	.011**	-.002	.002	-.007	.021*
	(.71)	(1.86)	(.25)	(2.55)	(.21)	(.23)	(.75)	(1.96)
dummy – well	.769**	-.283	-.047	.043				.573
	(2.24)	(.83)	(.14)	(.14)				(.92)
HYV seeds	-.607	.181	.866***	.132				.665
	(1.64)	(.69)	(2.83)	(.39)				(1.06)
IMR					-2.300***	-2.791***	-2.528***	-1.634
					(4.08)	(4.09)	(3.47)	(1.55)
Constant	-1.718***	-1.408***	-.690*	-.276	5.227***	5.361***	5.752***	3.524***
	(4.01)	(3.36)	(1.74)	(.69)	(3.84)	(3.32)	(4.37)	(2.74)
R-squared	.23	.29	.27	.16	.26	.36	.32	.29
Observations	450	450	450	450	450	450	450	450

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table AII-6. Income system, urban poor

	Participation – Probit				Level of income (log)			
	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self
Atlantic region	.821***	-.469**	-.386*	.378*	.136	.356	-.108	.410
	(3.39)	(2.13)	(1.85)	(1.84)	(.21)	(.69)	(.17)	(1.07)
Central region	.682***	-.143	-.347**	-.239	-.038	.010	-.028	.205
	(3.54)	(.81)	(2.09)	(1.36)	(.07)	(.03)	(.06)	(.71)
Managua	-.622	-.628**	.216	-.138	.862	.056	.389	-.097
	(1.52)	(2.24)	(.88)	(.52)	(1.26)	(.08)	(.59)	(.22)
Share of adults, agricultural wage	1.731***	-.542*	.320	.417	1.472			
	(5.06)	(1.83)	(1.10)	(1.41)	(1.20)			
Share of adults, non-ag. wage	-.036	1.192***	-.093	-.379*	-.161	.386		
	(.16)	(4.29)	(.48)	(1.79)	(.50)	(.57)		
Share of adults, non-ag. self-emp.	-.008	.029	1.612***	-.227			1.593	
	(.02)	(.08)	(4.35)	(.73)			(1.24)	
Share of adults, ag. self-emp.	.141	-.376	-.854*	1.989***				1.503
	(.28)	(.81)	(1.78)	(4.10)				(1.30)
Hh average years of education	-.081**	-.004	.001	.015	-.024	.059	.034	.053
	(2.04)	(.11)	(.02)	(.43)	(.30)	(.78)	(.44)	(1.04)
Technical assistance exists	-.131	-.494	.187	1.225***				1.069
	(.36)	(1.47)	(.53)	(2.74)				(1.61)
Pension	.321	.491	-.087	.017				
	(.68)	(1.34)	(.24)	(.04)				
Credit constraint	.208	.056	.045	-.042	-.037	.001	-.210	-.141
	(1.29)	(.38)	(.33)	(.29)	(.13)	(.00)	(.60)	(.62)
Paved access to home	.175	-.013	-.202	-.091			-.220	-.266
	(.70)	(.06)	(1.06)	(.45)			(.46)	(.83)
Land in annuals	-.011	.014	-.019	-.003				.028
	(.92)	(1.19)	(1.08)	(.30)				(1.50)
Value of assets for non-ag. business	-.000	.000	.000*	-.000	.000	-.000	.000	.000
	(1.25)	(1.04)	(1.78)	(1.06)	(.08)	(.23)	(.16)	(.04)
Migration assets	.324	-.355	-.196	-.263			.081	.222
	(1.16)	(1.40)	(.83)	(1.06)			(.14)	(.55)
Home asset index	-.085	.197**	-.032	-.051	.060	.135	.003	-.121
	(.78)	(2.17)	(.51)	(.63)	(.47)	(.78)	(.02)	(1.09)
Dirt floor	-.019	-.016	.048	.125	-.072	.066	-.071	-.096
	(.09)	(.10)	(.31)	(.78)	(.27)	(.19)	(.18)	(.36)
Family size	.039	.046*	.037	.007	-.001	-.021	-.005	.007
	(1.42)	(1.68)	(1.58)	(.29)	(.02)	(.37)	(.08)	(.18)
Dependency ratio	-.374	-.487	-.143	.146	-.184	-.395	-.358	-.219
	(.84)	(1.25)	(.41)	(.39)	(.27)	(.44)	(.39)	(.37)
Female headed household	-.280	-.198	.255*	-.086	-.072	.174	.233	-.092
	(1.51)	(1.28)	(1.75)	(.55)	(.23)	(.51)	(.57)	(.38)
Head of household age	-.008	.009*	-.009*	.002	.001	-.003	-.004	.001
	(1.47)	(1.76)	(1.86)	(.40)	(.07)	(.28)	(.28)	(.13)
IMR					-1.936**	-4.652***	-3.199***	-2.003***
Atlantic region					(2.11)	(4.53)	(2.94)	(2.89)
	-1.078**	.074	.081	-.770*	4.600***	7.545***	6.284***	3.503***
	(2.03)	(.16)	(.20)	(1.77)	(2.84)	(5.68)	(4.88)	(2.91)
R-squared	.27	.17	.13	.15	.27	.23	.17	.27
Observations	408	408	408	408	408	408	408	408

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table AII-7. Income system, urban non poor

	Participation – Probit				Level of income (log)			
	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self	Ag. Wage	Non Ag. Wage	Non Ag. Self	Ag. Self
Atlantic region	.096	-.330**	-.308**	-.041	.042	.054	.337	.204
	(.46)	(2.11)	(2.07)	(.28)	(.21)	(.15)	(.82)	(.82)
Central region	.020	-.075	-.141	-.185*	-.078	-.079	.205	-.053
	(.13)	(.66)	(1.29)	(1.67)	(.53)	(.30)	(.72)	(.22)
Managua	-.493**	.340***	-.182*	-.479***	.065	.135	.048	-.272
	(2.47)	(2.79)	(1.69)	(3.93)	(.35)	(.48)	(.16)	(.58)
Share of adults, agricultural wage	2.333***	-.403	-.254	-.036	3.511***			
	(5.52)	(1.06)	(.71)	(.10)	(5.14)			
Share of adults, non-ag. wage	-.225	1.272***	-.526***	.149	-.057	1.234**		
	(1.07)	(6.64)	(3.56)	(1.01)	(.32)	(2.36)		
Share of adults, non-ag. self-emp.	-.885***	-.525***	1.857***	.144			-.038	
	(2.92)	(3.05)	(9.03)	(.83)			(.05)	
Share of adults, ag. self-emp.	-.439	-1.077***	1.063***	.783***				1.549**
	(1.24)	(3.46)	(3.50)	(2.89)				(2.12)
Hh average years of education	-.050*	.073***	-.028*	-.019	-.003	.111**	.016	-.035
	(1.95)	(4.17)	(1.75)	(1.16)	(.12)	(2.56)	(.37)	(1.22)
Technical assistance exists	.514*	.034	-.315	.078				-.169
	(1.73)	(.13)	(1.21)	(.30)				(.38)
Pension	-.276	-.239	-.186	-.160	.016	-.109	-.172	-.008
	(.79)	(1.35)	(1.12)	(.83)	(.07)	(.26)	(.39)	(.02)
Credit constraint	-.217	-.043	.110	.071	.011	-.053	.011	.065
	(1.35)	(.43)	(1.15)	(.72)	(.08)	(.22)	(.04)	(.37)
Paved access to home	.153	-.214**	.082	-.066			.101	.057
	(.99)	(2.15)	(.89)	(.66)			(.42)	(.34)
Cattle [n. of cows]	.003	-.002	-.007**	.010**	.002	-.001	.012	.029***
	(.88)	(.72)	(2.22)	(2.12)	(.45)	(.14)	(1.40)	(4.10)
Land in annuals	.001	.001	-.002	.000	.001	.001	.001	.001
	(.40)	(.45)	(1.21)	(.16)	(.57)	(.17)	(.31)	(.49)
Value of assets for non agricultural business	-.000	-.000	.000	.000	.000	-.000	.000	.000
	(1.52)	(.29)	(.86)	(.16)	(1.61)	(.55)	(1.59)	(.03)
Migration assets	-.101	.252	-.062	.222			.110	.139
	(.37)	(1.28)	(.36)	(1.25)			(.25)	(.40)
Home asset index	-.056	-.038*	.013	-.063***	-.002	.025	.037	-.016
	(1.52)	(1.74)	(.68)	(2.79)	(.05)	(.51)	(.70)	(.24)
Dirt floor	.219	.084	-.194*	.168	.069	.059	-.095	.154
	(1.34)	(.68)	(1.68)	(1.47)	(.43)	(.21)	(.31)	(.65)
Family size	.055**	.122***	.061***	.022	.001	-.012	-.098*	-.002
	(2.26)	(5.26)	(3.26)	(1.15)	(.03)	(.20)	(1.75)	(.05)
Dependency ratio	-.072	-.771***	-.496***	-.337*	-.070	-.489	.062	-.342
	(.24)	(3.72)	(2.60)	(1.73)	(.27)	(.92)	(.11)	(.80)
Female headed household	-.374**	.060	-.250***	-.170*	.005	-.096	.071	-.193
	(2.56)	(.59)	(2.72)	(1.71)	(.03)	(.43)	(.26)	(.90)
Head of household age	.003	.003	.004	.011***	-.001	.012	-.008	.004
	(.58)	(.94)	(1.23)	(3.46)	(.21)	(1.54)	(.86)	(.42)
IMR					-.789***	-4.122***	-5.332***	-1.061
					(3.07)	(6.77)	(7.63)	(.91)
Constant	-1.223***	-.597**	-.009	-1.007***	2.227***	6.242***	8.862***	2.766
	(3.25)	(2.09)	(.03)	(3.72)	(3.46)	(6.39)	(9.63)	(1.61)
R-squared	.22	.21	.17	.08	.14	.28	.25	.13
Observations	1070	1070	1070	1070	1070	1070	1070	1070

Robust z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%