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Gandelman, Néstor

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Néstor Gandelman\*

Universidad ORT Uruguay

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Contact information: Nestor Gandelman, Department of Economics, Universidad ORT Uruguay, Bulevar España 2633, Montevideo, Uruguay. Tel: (5982) 707 1806 Fax: (5982) 708 8810. Email [gandelman@ort.edu.uy](mailto:gandelman@ort.edu.uy).

## Homeownership and Gender

### *Abstract*

The literature on the determinants of housing tenure often incorporates the gender of the household head as one exogenous explanatory variable. Several studies have found discrimination in favor of women and others fail to find significant results with respect to the household head gender. Given the outcomes, in other contexts, of the gender discrimination literature these results are surprising. In this paper, we argue that several determinants of household headship also affect homeownership and that failing to explicitly account for this endogeneity leads to inconsistent results. We estimate a recursive bivariate probit and find evidence of discrimination against women in the housing market. According to our estimates the traditional approach gives the wrong sign for the effect and overestimates the marginal effect of women headship by 10%.

## 1. Introduction

There is a large literature on the analysis of housing tenure choice. One dimension that has been often incorporated into the empirical analysis is whether the household head is a man or a woman. Surprisingly, very few authors comment on their results of household headship. In this paper, we argue that the determinants of women household headship and those of homeownership are correlated and therefore the specification used in most studies has an endogeneity problem that leads to inconsistent and often counterintuitive results.

If women's marital status is not exogenous to the tenure choice, then, even in the presence of discrimination against women in the housing markets, a naive view of the data may reflect that women headed households have higher probabilities of owning their home. For instance, those women that do not have a place were to live, have lower income, have more children, etc. will probably not divorce their husbands even if they want to. Therefore, there is a selection bias in which woman headed families tend to have better socioeconomic indicators than what they would have if woman headship were a completely exogenous process.

Properly understanding the gender dimension of homeownership and evaluating potential gender discrimination is of fundamental importance to conduct and implement good housing policies. To the best of our knowledge there is no paper that focuses on the factors affecting homeownership and household headship jointly. In this note, we try to correct this shortcoming by estimating a recursive bivariate probit for the particular case of Uruguay (but exactly the same methodology can be applied to any country). This paper contributes to the literature on several grounds. First, it argues there is an endogeneity flaw in most of previous studies. Second, it proposes a simple way to adequately estimate the determinants of homeownership. Third, using data on Uruguay, it shows important qualitative and quantitative differences in the determinants of homeownership when they are estimated with and without assuming exogeneity of women household headship.

The study of the determinants of housing tenure and the concerns with possible discrimination has been on the research agenda even before appropriate econometric techniques were commonly used. For instance, Kain and Quigley (1972), McDonald (1974) and Struyk (1974) use linear models to estimate the "probability" of being a homeowner. The latter paper avoids the problem of women headed households by using data only on husband-wife families. Despite the flaws in the econometric technique Kain and Quigley (1972) is the only paper that concludes there is discrimination against women and non-white. McDonald (1974) suggests that the results in Kain and Quigley (1972) may be due to a simultaneous decision on the type of house tenure and the house structure type that leads to an endogeneity problem. McDonald's argument is in spirit similar to the one we make in this paper. Li (1977) is the first paper that goes beyond linear models and estimates a logit model to the determinants of homeownership but does not consider the gender of the household head.

Several types of variables have received most of the attention of the researchers: income and wealth, life cycle status, location and neighborhood attributes and a variety of socioeconomic indicators. In particular, much attention has been given to the racial or

ethnic origin of the father. There is substantial evidence of racial discrimination. The economic discrimination literature has also spent lots of efforts to study the existence of gender discrimination on several dimensions (income, promotions, etc). One of the most common strategies is to include as an explanatory variable a dummy for women and conclude that if the estimated coefficient is significantly different from zero, women receive a discriminatory (positive or negative) treatment with respect to men. It is therefore striking the absence of comments on discrimination in the studies of the determinants of homeownership. The reason of this is that most studies find discrimination in favor of women or fail to find discrimination at all.

Van Leuvensteijn and Koning (2004) studying the relations between homeownership and labor mobility find that women have higher probabilities of owning their household. Chiuri and Jappelli (2003) using data for fourteen OECD countries in their study of the effects of financial market imperfections on homeownership do not find any difference in the probabilities to own their home form men and women. Arimah (1997) studying explicitly the determinants of housing tenure in Ibadan (Nigeria) does not find any difference between men and women for the whole city. Manrique and Ojah (2003) using data disaggregated into primary and secondary housing demand in Spain found that men are more likely to own their household but women tend to have higher household expenditure. Even in my own work (Gandelman and Gandelman 2004), instead of finding evidence in favor of discrimination of households headed by women, I found the probability of having access to mortgage credit and to owning their house to be higher for women headed families.

The paper proceeds as follow: section two present the conceptual and econometric framework, section three presents the data, section four the results and finally section five concludes.

## 2. Theoretical framework and econometric strategy

The traditional approach to estimating the determinants of homeownership is to postulate a structural equation

$$Own^* = x' \beta + \varepsilon \quad (1)$$

where  $Own = 1$  if  $Own^* > 0$  and  $\varepsilon$  is an error term assumed to distribute normal or logistic. All explanatory variables in  $x$  are assumed to be exogenous.

Nevertheless, there is evidence that divorces are affected by several income and welfare variables. For example, Shroder (2002) reviews the evidence on indirect effects of housing assistance on the self-sufficiency of assisted families. He concludes that there is a strong association of housing assistance with single-adult household formations. Other papers that report similar evidence include Danzinger et al. (1982), Hannan and Tuma (1990), Groeneveld, Tuma and Hannan (1980) and Hannan, Tuma and Groeneveld (1977). It is therefore natural to assume that some of the variables that increase the probability of owning a house also increase the probability of observing women headed families. If this endogeneity is neglected the estimated coefficients of model (1) are inconsistent.

Therefore we postulate a recursive bivariate probit model in which it is possible to test whether woman headship and housing tenure are exogenous. The model is based on two structural equations of the following form:

$$Own^* = \beta_1' x_1 + \gamma Woman + \varepsilon_1$$

$$Woman^* = \beta_2' x_2 + \varepsilon_2$$

where  $Own^*$  and  $Woman^*$  are latent variables,  $Own$  and  $Woman$  are dichotomous variables that take the following values:

$$Own = \begin{cases} 1 & \text{if } Own^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad Woman = \begin{cases} 1 & \text{if } Woman^* > 0 \\ 0 & \text{otherwise} \end{cases}$$

$x_1$  and  $x_2$  are vectors of exogenous variables,  $\beta_1$  and  $\beta_2$  are vector of parameters,  $\gamma$  is a scalar parameter and the error terms are assumed to be distributed bivariate normal with mean 0, variance 1 and correlation  $Cov(\varepsilon_1, \varepsilon_2) = \rho$ . While the bivariate probit model can be identified based on the functional form assumptions of the joint normal distribution and therefore there is no need for any extra identification strategies some of the determinants of homeownership should not affect the gender headship regression and vice versa.

As shown in Greene (1998) and Greene (2003), despite the endogeneity of woman headship, this multiple equation specification for two dichotomous variables can be consistently estimated by Full-Information Maximum Likelihood (FIML) methods.<sup>1</sup> The intuition behind this result is that the four probability terms that enter the likelihood function can be decomposed in the conditional and the marginal distribution for women. For instance,  $P(Own = 1, Woman = 1) = P(Own = 1 | Woman = 1)P(Woman = 1)$ .

The loglikelihood function to be maximized is given by:

$$\ell(\beta) = \sum_i^N [d_{11} P_i^{11} + d_{10} P_i^{10} + d_{01} P_i^{01} + d_{00} P_i^{00}]$$

where:

$$\begin{aligned} d_{11} &= Own_i Woman_i & P_i^{11} &= P(Own = 1, Woman = 1) = \Phi_i(\beta_1' x_{1i} + \gamma, \beta_2' x_{2i}, \rho) \\ d_{10} &= Own_i (1 - Woman_i) & P_i^{10} &= P(Own = 1, Woman = 0) = \Phi_i(\beta_1' x_{1i} + \gamma, -\beta_2' x_{2i}, \rho) \\ d_{01} &= (1 - Own_i) Woman_i & P_i^{01} &= P(Own = 0, Woman = 1) = \Phi_i(-\beta_1' x_{1i}, \beta_2' x_{2i}, \rho) \\ d_{00} &= (1 - Own_i)(1 - Woman_i) & P_i^{00} &= P(Own = 0, Woman = 0) = \Phi_i(-\beta_1' x_{1i}, -\beta_2' x_{2i}, \rho) \end{aligned}$$

and  $\Phi_i(\dots, \rho)$  is the bivariate normal distribution assumed for the perturbations.

This nice result of the bivariate probit model has already been used in empirical work in various areas. Greene (1998) studies the probability of a gender economic courses at Liberal Arts Colleges, White and Wolaver (2003) focus on occupation choice and migration and Greene, Rhine and Toussaint-Comeau (2003) study the decision to patronize check-cashing businesses and the decision to be unbanked. Fabbri, Monfardini and Radice (2004) focus on cesarean delivery utilization across public and private hospitals. This last paper presents Monte Carlo evidence that testing the null of  $\rho = 0$  is a valid test for exogeneity.

<sup>1</sup> A two-stage procedure paralleling 2SLS for linear simultaneous equations models will yield inconsistent results as discussed in Wooldridge (2003).

### 3. Data

In this paper we use data from the Household Survey in Uruguay for the year 2002. The Household Survey is conducted by the Instituto Nacional de Estadísticas (INE) on a monthly base.

The Household Survey distinguishes five categories: owner that already finished paying, owner still paying, renters, users without paying rent but with owners' approval, and users without paying rent and without owners' approval. Of the total 18.421 households, 58% own and finished paying, 11% own and are still paying, 16% rent and 15% use it without any payment. Our variable of interest differentiates between owners (first two lines in Table 1) and renters (third line in Table 1) taking the value of 1 if the household owns and 0 if the household pays rent.<sup>2</sup>

	Cases	
Own, already paid	10645	58%
Own, still paying	2074	11%
Rent	3034	16%
Use with owner approval	2524	14%
Use without owner approval	144	1%
Total	18421	100%

Source: INE

Table 2 and 3 show descriptive statistics of candidate determinants of the model disaggregated by housing tenure and household head gender. Some of the variables are for the household as a whole and some are characteristics of the household head.

The variables of interest can be classified in the following four categories: income, life-cycle status, location and neighborhood attributes and other socioeconomic characteristics. We define two income-related variables: total household income (*IncomeHouse*) and total income of the woman of the house<sup>3</sup> (*IncomeWoman*). Women that earn by themselves more money are likely to feel more independent and therefore this may affecting the decision to remain married or not. We also considered three life-cycle status variables: age of the household head (*Age*), a dummy that takes the value of 1 if the household head is married and 0 otherwise (*Married*), another dummy that takes the value of 1 if there are children under 18 present in the house and 0 otherwise (*DummyChildren*) and the amount of children under 18 in the house (*Children*). With respect to location *City* is a dummy that takes value one if the house is in the capital city Montevideo (49% of the survey). There are cultural differences between inhabitants of the capital city and the rest of the country. Being the latter more conservative we expect to have a higher proportion of women headed in Montevideo. Finally, *Woman* is a dummy that takes the value 1 if the household head is a woman and *Schooling* is years of education of the household head.

<sup>2</sup> We also consider renters and users as one single category and differentiated them from owners. The results are similar.

<sup>3</sup> She may be the household head or the household head's wife.

As expected owners have a higher income level than renters. On average, owners are ten years older than renters but surprisingly, renters are on average more educated than owners. Given the improvements in education level over the last decades it is not surprising that the younger group is more educated than the older one. If we restrict our data to those households-heads between 25 and 50 years old the differences in education vanishes. Owners between 25 and 50 years old have in average 10.6 years of study and renters have on average 10.3 years.

Simply looking at the means, there are no differences in the percentage of women household heads of owners and renters (34% and 33% respectively). With respect to life-cycle variables about 57% of all households have children present with no significant differences between owners and renters. There does not seem to be differences in the presence of children but owners have slightly more children than renters.<sup>4</sup> About 55% of homeowners are married but only 42% of renters are. If a person does not believe his actual mate to be stable, it is natural that he may not be interested in getting into a long-term contract as a housing mortgage credit. He will prefer a more flexible housing solution like renting. The household head being married and the presence of children are proxies of family stability. Finally, it is more common to rent in the capital city than in the rest of the country.

Breaking the analysis on the household head dimension we also observe very reasonable results. Those households headed by men have higher total income than those households headed by women. The income of the woman of the house in man headed households is lower in percentage terms with respect to total income but also in absolute terms. Woman household heads seem to be older than man household heads but there does not seem to be significant differences with respect to education. As expected, only a very small proportion of woman household heads are married and they have about 50% percent less children than households where the household head is a man. Finally, woman household heads are more concentrated in the capital city.

**Table 2. Descriptive Statistics according to housing tenure**

	Owners		Renters		Total	
	Mean	St.error	Mean	St.error	Mean	St.error
IncomeHouse	17.62	0.150	13.10	0.242	16.75	0.131
IncomeWoman	4.86	0.064	4.44	0.108	4.78	0.055
Women	0.34	0.004	0.33	0.009	0.34	0.004
Age	57.60	0.138	47.57	0.316	55.67	0.131
Schooling	8.76	0.040	9.26	0.072	8.86	0.035
Married	0.55	0.004	0.42	0.009	0.52	0.004
DummyChildren	0.57	0.004	0.56	0.009	0.57	0.004
Children	1.06	0.011	1.01	0.022	1.05	0.010
City	0.55	0.004	0.67	0.009	0.57	0.004

Note: IncomeHouse= total household income, IncomeWoman= total income of the woman of the house, Woman=1 if household the head is a woman, Age = household head age, Schooling= household head years of education, Married=1 if household head is married, DummyChildren=1 if there are children present in the household, Children=amount of children under 18 in the house and City= 1 if the household is located in Montevideo (the capital city).

<sup>4</sup> It may be surprising that the average for Children is around 1 but it should be noted that this is the average number of children per household and not per family.

	Man		Woman		Total	
	Mean	St.error	Mean	St.error	Mean	St.error
IncomeHouse	16.98	0.157	13.16	0.142	15.71	0.116
IncomeWoman	3.08	0.052	7.24	0.097	4.46	0.049
Age	52.24	0.145	59.09	0.219	54.52	0.123
Schooling	8.71	0.038	8.49	0.058	8.64	0.032
Married	0.71	0.004	0.09	0.004	0.51	0.004
DummyChildren	0.62	0.004	0.49	0.006	0.58	0.004
Children	1.25	0.012	0.84	0.014	1.11	0.009
City	0.53	0.004	0.61	0.006	0.56	0.004

Note: IncomeHouse= total household income, IncomeWoman= total income of the woman of the house, Woman=1 if household the head is a woman, Age = household head age, Schooling= household head years of education, Married=1 if household head is married, DummyChildren=1 if there are children present in the household, Children=amount of children under 18 in the house and City= 1 if the household is located in Montevideo (the capital city)

#### 4. Results

Table 4 shows the results of the traditional probit estimation and the recursive bivariate probit model. The first thing to note is that the sign of *Women* in the Homeownership regressions is reversed. Therefore, in the bivariate probit model we recover the intuitive result that single mother families are not in a better situation than husband-wife families in what respect to homeownership. There are also small changes in the estimated coefficients of all the other variables but to understand the differences in those changes we need to consider the marginal effects.

Note also that the likelihood ratio test for the correlation of the error terms rejects the null of  $\rho = 0$ . Therefore estimating both equations independently is incorrect.

Independent Probit Models			Bivariate Probit Model				
Dependent variables	Coef.	Standard errors	Dependent variables	Coef.	Standard errors		
Own	Woman	0.134	0.031***	Own	Woman	-0.261	0.115**
	IncomeHouse	0.013	0.001***	IncomeHouse	IncomeHouse	0.015	0.001***
	Age	0.024	0.001***	Age	Age	0.025	0.001***
	Married	0.323	0.030***	Married	Married	0.319	0.030***
	Children	0.086	0.013***	Children	Children	0.062	0.015***
	Schooling	-0.007	0.004*	Schooling	Schooling	-0.005	0.004
	Constant	-0.810	0.069***	Constant	Constant	-0.799	0.069***
Woman	IncomeWoman	0.061	0.002***	Woman	IncomeWoman	0.061	0.002***
	Age	0.011	0.001***	Age	Age	0.010	0.001***
	Children	-0.164	0.012***	Children	Children	-0.216	0.014***
	City	0.018	0.021	City	City	0.052	0.025**
	Constant	-1.241	0.047***	Constant	Constant	-1.238	0.053***
					$\rho$	0.259	0.072
			Likelihood ratio test of $\rho = 0$ :37.20				

Note: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

IncomeHouse= total household income, IncomeWoman= total income of the woman of the house, Woman=1 if household the head is a woman, Age = household head age, Schooling= household head years of education, Married=1 if household head is married, Children=amount of children under 18 in the house and City= 1 if the household is located in Montevideo (the capital city).

When estimating bivariate probit models there are several marginal effects of interest. Table 5 reports the effects of a change in the explanatory variables on the unconditional probability of being a homeowner. By far the greater difference between both models is in the estimated marginal effect of women headship. The simple probit model provides the wrong impression that woman household heads have a 3% higher probability of being homeowners. Accounting for the endogeneity of household headship we get that those household with a woman head have 7% lower probability of being owners. Therefore the marginal effect of the simple probit model is overestimated by more than 10%.

With respect to the other determinants, in general all coefficients have the expected signs. Higher income increases the probability of being a homeowner. The lifecycle variables are also significant. The older the household head the higher the probability of being a homeowner. Being married and the amount of children also affects positively the probability of owning. In the simple probit model, education has a negative sign and is significant at 10%. In the bivariate probit model it remains the negative sign but the coefficient is not statistically different from 0. Therefore, there does not seem to be a differentiated effect of education on homeownership (i.e. effects of education that are not implicit in other variables like income). Of these marginal effects the only other variable where there is a sizeable difference between the two estimation techniques is in the amount of children. The simple probit model over estimates the effect of one extra children in the probability of being a homeowner in 0.6%.

Table 5. Probability of being a homeowner				
Marginal effects				
	Probit		Bivariate Probit	
		Standard errors		Standard errors
Woman	3.340%	0.0077***	-6.980%	0.0325**
Income House	0.333%	0.0003***	0.384%	0.0003***
Age	0.611%	0.0002***	0.653%	0.0003***
Married	8.293%	0.0078***	8.251%	0.0077***
Children	2.198%	0.0034***	1.598%	0.0037***
Schooling	-0.179%	0.0009*	-0.125%	0.0009

Note: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%  
IncomeHouse= total household income, Woman=1 if household the head is a woman, Age = household head age, Schooling= household head years of education, Married=1 if household head is married, Children=amount of children under 18 in the house and City= 1 if the household is located in Montevideo (the capital city).

Besides the differences in the marginal effects in both estimation strategies, the bivariate probit model allows to disaggregate the marginal effects in a direct and an indirect effect (Greene 1996) and therefore a better understanding of the affecting channels. Table 6 disaggregates the marginal effects in its direct and indirect components for the conditional probability of being a homeowner given that the household head is a woman and for the conditional probability of being a homeowner given that the household head is a man.

The higher the income of the woman of the house the higher the probability that the woman chooses to head her own house. But since women headed household have lower probability of owning their house it results that the higher the income of the woman of the house the lower the probability of family homeownership. On the other hand, the higher the household income the higher the probability the family owns their house. In

line with our previous explanations the marginal effect of household income is higher for man household heads.

Living in the capital city increases the probability of woman headship (the simple probit fails to generate this results) but since woman heads have lower probability of being homeowners the impact of living in the city on homeownership is negative.

In general, the marginal effect of all significant variables is higher for men than for women. This is indicative of the worse position of women headed families with respect to the probability of becoming homeowners through time and even after improvements in the other determinants.

Table 6. Conditional probability of Homeownership				
Marginal effects				
Probability of Homeownership given Household head is a Woman				
	Direct	Indirect	Total	Standard Errors
Income House	0.280%		0.280%	0.0002***
Income Woman		-0.220%	-0.220%	0.0004***
Age	0.470%	-0.040%	0.430%	0.0004***
Married	5.970%		5.970%	0.0074***
Children	1.160%	0.790%	1.950%	0.0026***
Schooling	-0.090%		-0.090%	0.0007
City		-0.190%	-0.190%	0.0009*
Probability of Homeownership given Household head is a Man				
	Direct	Indirect	Total	Standard Errors
Income House	0.460%		0.460%	0.0002***
Income Woman		-0.220%	-0.220%	0.0006***
Age	0.740%	0.040%	0.780%	0.0003***
Married	9.320%		9.320%	0.0090***
Children	1.820%	0.800%	2.620%	0.0039***
Schooling	-0.170%		-0.170%	0.0010
City		-0.200%	-0.200%	0.0010

Note: \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%  
IncomeHouse= total household income, IncomeWoman= total income of the woman of the house, Woman=1 if household the head is a woman, Age = household head age, Schooling= household head years of education, Married=1 if household head is married, Children=amount of children under 18 in the house and City= 1 if the household is located in Montevideo (the capital city).

## 5. Conclusions

Although there is a large literature on the determinants of housing tenure and although there is also a large literature on women discrimination there are no studies that point that women suffer of discrimination in the sense that -all the rest equal- they have lower probabilities of owning their house. Actually, although not explicitly mentioned, several studies find a type of discrimination in favor of women.

We argue in this paper that these results are flawed since the housing tenure decision and the housing headship decisions should not be treated as exogenous. Among the variables that enter the decision of a woman to divorce his husband are income related issues and family life cycle dimensions that also affect the probability of owning their house. Just to consider an extreme case, if the woman is the main income provider of the house and is tired of her husband she may decide to divorce him. On the contrary, if

the same tired woman is economically dependent on her husband, she may remain married. If this type of endogeneity is not properly accounted, it leads to inconsistent and often counterintuitive results.

In this paper, we correct this shortcoming of the literature by estimating a recursive bivariate probit for the particular case of Uruguay. In this way, we can easily incorporate the endogenous nature of housing tenure and housing headship. We found that a naive simple probit model seems to imply that women headed families have higher probability of owning their home. Once we estimate the bivariate probit model and control for endogeneity we get that women headed families have lower probability of owning their home. The marginal effects of women headship are overestimated by 10% if not properly estimated.

With respect to the other variables, as expected, we found that the higher the income of the family the higher the probability of owning their home. The higher the income of the woman of the house the higher the probability of having a woman headed family. The older the household head the higher the probability of being a homeowner. Family status variables like being married and having children have a positive direct effect on the probability of being a homeowner. Since the amount of children decreases the probability of women headship the amount of children produce also positive indirect effect on the probability of homeownership. Finally, schooling turn not to be significant.

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