A strategic modeling of the Tunisian married-women labor supply process

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Abstract: In this paper, we consider the problem of married-women labor supply process estimation under the hypothesis of strategic interaction with their partners. Based on the theory of household models, discrete choices models and game theory, we present the labor supply decision-making process of married women in the form of an extensive tree of game. Therefore, we try to estimate the process using a recent approach of discrete choices (strategic approach) and specifying via equations structural its advantage in the study of strategic data. Applying the strategic model on individual Tunisian data, observed in 2001, enables us to note that as contrary to woman expectations, financial side is not a determining factor of husband reaction once his wife gave up her work. This result observed only by taking into account the effect of strategic interaction.

Keywords: labor supply of married women, utility maximization, decision tree, strategic model.

1. Introduction

The New Household Economy attempts to explain the behavior of agents within the household such as fertility, marriage, divorce, number and quality of child, labor supply to each member of household and the division of labor between employment market and non-employment market, based on the notion of individual rationality resulting in a program of utility maximization under constraint. The utility depends on the characteristics of individual “i” and characteristics of his spouse. In fact, the decision of participating women into labor market to continue to work or not was been the subject of several research papers. Indeed, economists such as Becker (1973) and Fortin and Lacroix (1997) study, using a unitary household model, the labor supply of each member in the couple with a program of maximizing a household utility by aggregating all preferences in a welfare function. Others economists such as Chiappori et al (2002) and Sofer (1999) are based on non-unitary (collective or strategic) modeling to analyze the market labor supply and household work supply for each member of a couple where each one maximizes its own utility subject to budget and time. Although most household and labor economists assume that the decision to participate or not in the labor market is a strategic decision, but empirical studies of labor supply of household members were been limited to classical discrete choice models (probit or selection model) to estimate such a decision by neglecting the presence of strategic interaction between the two partners.

Thus, we try in this paper to shape a simple decision (or conflict) process of married-women labor supply,

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2 Labor market is the labor in market employment (job) and labor in non employment market is the domestic work (washing dishes, cleaning, meals, the Parenting Time, child education… etc.), for details see Becker 1973.
3 we neglect the work children and we observe only the work of the parents
4 The error is assumed to be normally distribution with mean zero and variance one (for Probit model) or if the error term is distributed double exponential regression (for Logit model).
taking into account the strategic interaction between its decision and the reaction of her husband. To meet our objectives, we organized our paper as follows: First, we present the labor supply decision process of married-woman (she continues to work after marriage or not) as a tree of the game by defining the players, actions or decisions and possible outcomes of the game. In the second section, we specify structural equations of our strategic model while identifying, on the one hand limits of traditional models to estimate strategic decision process (where the data are generated by a strategic process) and on the other hand, advantages of the strategic approach that highlights the presence effect of the interaction between actors. Finally, we interpret estimation results of strategic model of our decision process using 1396 Tunisian couples from the survey PAPFEM 2002.

2. A simple decision process

Consider a simple conflict (or decision) scenario within the household about women labor supply. Figure 1 displays this simple scenario which can be called as a game composed by two actors (W: woman, M: Man), a set of possible actions \( \{a, -a, \text{ref}, \text{accp}\} \) defined for each information set. Partner’s action leading to three possible outcomes \( \{\text{IS}, \text{CS}, \text{SS}\} \) of the game and denoted in the terminal nodes of the decision tree and decision makers (spouses) are assumed to have preferences over outcomes which are represented to their payoffs (utilities, profits, costs...etc.). Once the marriage is realized at time \( t \), women (participating in the labor market before marriage) must decide between abandon his job "a" or continue to work "-a". If she continues to work (she chooses "-a"), then the game ends with initial situation (IS) as the outcome and we note the absence of conflict between partners because There is no change of situation compared to the wedding day (the man choose a participating partner in the employment market and she continues to work after marriage). However, if the woman leaves her job after marriage (she chooses "a"), so the husband knowing and observing the woman’s decision can refuse "ref" or accept "accp" the decision of his wife, and leads to either a conflict situation (CS) or satisfaction situation (SS). For each outcome, the observable component of the player’s utility is denoted by \( U_{ik} \), where \( i \) indexes the player (in our case partner) and \( k \) indexes the outcomes. We assume that the partners are rational and maximize always their possible payoffs (utilities) of the game.

\[
\begin{align*}
\text{Decisions:} & \\
\text{a: the woman leaves his job} & \\
\text{-a: the woman continues to work} & \\
\text{accp: the husband accepts wife’s decision} & \\
\text{ref: the husband refuses wife’s decision} & \\
\text{Outcomes:} & \\
\text{IS: initial situation} & \\
\text{CS: Conflict situation} & \\
\text{SS: satisfaction situation} & \\
\end{align*}
\]

\[y_w = y_a = 0\]  
\[y_w = y_a = 1\]  
\[y_w = 0\]  
\[y_w = 1\]  
\[U_{IS}, U_{CS}, U_{SS}\]  
\[U_{a}, U_{-a}, U_{\text{accp}}, U_{\text{ref}}\]

\[y_m = 1\]

\[a\]

\[M\]

\[W\]

\[\text{IS} \]

\[\text{CS} \]

\[\text{SS} \]

\[U_{\text{accp}}\]

\[U_{\text{ref}}\]

\[U_{\text{a}}\]

\[U_{\text{-a}}\]

\[U_{\text{IS}}\]

\[U_{\text{CS}}\]

\[U_{\text{SS}}\]

\[\text{Figure 1. married-women labor supply process}\]

\[3\] Our model can be used to explain any strategic choice or decision (to marry or not, to migrate or not, to invest or not ... etc.)
To estimate our process decision, we must reform this theory representation to a statistically representation determining the estimate function. To this end, we use the strategic discrete model that take in account the effect of strategic interaction between actors in decisions and therefore on the outcome of the "game". We see from this game tree, the presence of interaction between the wife and husband's reactions.

In fact, the woman does not want a conflict situation with her husband that can bring to a marriage dispute in which partners continue to live together but in disagreement situation that make them choosing the separation (divorce) if the menace points of man are interesting (such as the possibility of remarriage, positive additional utility with another wife).

3. Modeling married-women labor supply process

We analyze the conflict scenario by assuming that decisions of partners are not only sequentially, but strategically. i.e. we assume that woman chooses between quit or not his job taking into consideration that husband will refuse or accept his decision. Given that woman chooses to quit; the man decides between accept or refuse based on a utility maximization program. Before applying the strategic model (which is a combination of traditional discrete choice models and game theory) of our decision process, first we present limits of traditional models (probit and selection models) to model it, given that the data are generated by a strategic process.

3.1. Limits of traditional models

Most analysts have assumed that labor supply decision is strategic, but they have been limited in most cases in their empirical methods (such as in figure 1). the Probit or Logit models by neglecting the effect of the presence of strategic interaction between the two partners. Those models are to consider that the probability of realization a particular action (the decision) or outcome (situation) is the dependent variable from a certain decision rule defined by a latent variable based on a set of exogenous variables. Given the Probit modeling, the latent variable, \( y^* \), is a linear function of a set regressors associated to woman and of a set of regressors associated to husband.

\[
 y^* = X\alpha + Z\beta + \varepsilon
\]

\( \alpha \) et \( \beta \) are coefficient vectors on \( X \) and \( Z \), respectively, and \( \varepsilon \) is a random disturbance vectors, assumed to be normally distributed with mean zero and variance one. We do not observe the latent variable, \( y^* \), but we observe only the decision of each member. That is the model of each member

\[
y = \begin{cases} 
 1 & \text{if } y^* > 0 \\
 0 & \text{otherwise}
\end{cases}
\]

We assume that only two outcomes are possible in this process because data are coded with "1"if the response is favorable (the woman leaves her job and about the men, he accepts decision of his wife to quit

\footnote{For limits of traditional models, see Haj Ali and Zaiem (2008) and Clarke and Signorino (2004)}
her job) or "0" for any other answers. Therefore, "1" represents the realization of an action or outcome to be studied and "0" represents any other result. Thus, it's assumed that only two possible outcomes of this process are the conflict situation “CS” and the absence of the conflict “C̅S”, where C̅S is the aggregation of both initial situation (IS) and satisfaction situation (SS).

But really, it is difficult to study the two results of probit model for the following reasons: first, we must assume the existence of a no observable aggregation rule of the two results (IS and SS) and next, applying the Probit model supposing that each player (partner) has complete information on the decision model of his spouse, especially on his reaction, his decision and his preferences, or really this is not always true. Such limits have led econometrists to find models that satisfy the requirements of the studies of strategic data, hence the use of selection model\(^7\). The selection model retrains the original sequential choice structure depicted in figure 1. In this model, the woman chooses between actions “” and “a” without comparing IS utility and those associated SS and CS results. That is, the woman's decision depends on its characteristics and she does not anticipate the reaction of her husband (that depends of husband’s observable and unobserved characteristics), contrary to the man decision after having known and observed his wife’s decision. We find then that the woman's decision is strategic (because it affects the decision of her husband), but the husband's decision is not strategic (since the equations structure of women selection traditional models does not condition its decision by the reaction of her husband). We can then say that the selection model is partially Strategic\(^8\).

Such selection model limit, in the identification of strategic interaction, provided the discrete choice strategic model that overcomes inadequacies of traditional models (in Probit: simultaneous actions and the selection model is partially strategic) in the study of strategic data such as decision of married-women labor supply.

### 3.2. Strategic model of married-women labor supply process

In first step of selection model, the decision of woman “-a” or “a” (continues to work or not) does not take into account the reaction of her husband. On the contrary, strategic model assumes that the woman’s choice between “-a” and “a” depends on her expected husband’s reaction. i.e. wife conditions its decision on what he expected husband to do. Because woman does not perfectly observe man’s utilities, she can only estimate the probability that man will accept or refuse. Therefore, woman’s utility for quit her job is an expected utility, based on the lottery representing whether man will accept or refuse a wife’s decision. Given that, woman choose to quit her job, man then decides between accept or refuse the decision of his wife. We recall that the decisions of partners are identified by a simple utility maximization program\(^9\). Formally, the decision rule relates directly the dependent variable (an action or a result) to the explanatory variables that form the utility function (in this paper, the latent variable is a utility function). We normalize the IS payoff women to zero. The SS and CS payoff for woman are respectively \(X_3\alpha_3\) et \(X_4\alpha_4\).

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\(^7\) Selection models are all models which take the form of our decision tree [see Gouriéroux [4] and Greene [5]. The models are called selection models by econometrist because the first decision selects the sample from the second group (the second player of the tree) that participates in the game. Among these models, we cites: Multinomial Probit, sequential Logit, multinomial Logit.

\(^8\) See Signorino 1999

\(^9\) Partners are assumed to have preferences over outcomes, which are represented by their utilities for those outcomes. Each member chooses the action which she has the highest utility.
Selection model overcomes the disadvantage of simultaneous actions in the probit modeling but combines the factors that influence (encouraging and discouraging) wife’s decision into $X\alpha$ leading to outcomes SS and CS. In the strategic modeling, we disaggregate (separate) these factors into (1) those that affect wife’s payoff for the SS outcome ($X_3\alpha_3$) and (2) those that affect wife’s payoff for the CS outcome ($X_4\alpha_4$). As before, we normalize husband’s payoff for the SS at zero, and we let its payoff SC be $Z\beta$. We assume that a disturbance is associated with expected utilities at each information set, and that the disturbances are independently distributed standard normal. We assume that the best outcome for both partners is SS, where each partner has the highest utility value. Thus, our strategic model can be defined by the following tree:

$$y_w^* = p_{ref} X_3\alpha_3 + p_{accp} X_4\alpha_4 + \epsilon_1$$

$$y_w = 1 \text{ if } y_w^* \geq 0$$

$$y_m^* = Z\beta + \epsilon_2$$

$$y_m = 1 \text{ if } y_m^* \geq 0$$

Figure 2. Strategic model of married-women labor supply process

$y_W$, instead of utility in traditional models, then, the woman model is defined by its latent variable represented as follows:

$$y_{w,i}^* = p_{ref} X_3\alpha_3 + p_{accp} X_4\alpha_4 + \epsilon_i = \phi(Z,\beta)X_3\alpha_3 + [1 - \phi(Z,\beta)]X_4\beta_4 + \epsilon_i$$

\[
\begin{align*}
\text{if } y_{w,i}^* \geq 0 & \Rightarrow \text{ woman } i \text{ decided to quit his job} \\
\text{if } y_{w,i}^* < 0 & \Rightarrow \text{ woman } i \text{ decided to continues to work}
\end{align*}
\]

Therefore, the model of each woman is written: $y_{w,i} = \begin{cases} 
1 & \text{if } y_{w,i}^* \geq 0 \\
0 & \text{if } y_{w,i}^* < 0 
\end{cases}$

$^{10} X$: Matrix of characteristics of woman.

$^{11} Z$: Matrix of characteristics of man.

$^{12} \epsilon_i$ is a random disturbance, assumed to be normally distributed with mean zero and variance one.
we seek to model the abandonment of work or not by a married woman, then the decision is positive (denoted \( y_w = 1 \)) if the woman chooses "a" due to the positive utility affected after abandoning his work. Otherwise the woman's decision is negative (she continues to work) and it is denoted \( y_w = 0 \). About the husband, and after knowing the choice of his wife, the expected and desired husband’s reaction is acceptance the decision of his wife. So husband's decision is positive (denoted \( y_m = 1 \)) if he accepts that his wife quit his job and this is explained by the positive utility \( y_m^* \) touched by the husband after non-participation of his wife in the labor market. Then the man reacts as his model written as follows:

\[
y_{m,i}^* = Z_i \beta + \varepsilon_{2,i} \tag{13}
\]

\[
y_{m,i} = \begin{cases} 1 & \text{if } y_{m,i}^* \geq 0 \\
0 & \text{if } y_{m,i}^* < 0 \end{cases}
\]

\[
y_{m,i} = \begin{cases} 1 & \text{if } y_{m,i}^* \geq 0 \Rightarrow \text{man accepts the decision of his wife} \\
0 & \text{if } y_{m,i}^* < 0 \Rightarrow \text{man refuses his wife's decision} \end{cases}
\]

4. Estimation and Results

4.1. Data

This study uses data from the Survey PAP-FAM, realized in 2001 by the National Family and Population office (ONFP) of Tunisia. The survey covers 6691 households representing 4346 couples (women aged 15 to 54 years). It consists of several questionnaires including the household questionnaire that describes the household concerned, providing information on its composition, socioeconomic characteristics of its members, job, spouse's age, educational level of each one of them, marital status, residence and information on parents and children. Of other questionnaires that describe the health, the type of housing and other phenomena. Furthermore, the scenario that should be studied in this paper is as follows: here, there are women who want to quit job after marriage for a specific reason. We assume that this decision is the result from the fact that they want to care for their children's. Such a decision of married women may be accepted or refused by their spouses. We have a sample of 1396 pairs of observations (man-woman) that all women have participated before marriage in the labor market and this explanatory variables are: age of woman denoted w103c (from 16 to 54 years), number of children denoted ww109 (between 0 and 12 children), number of woman education years denoted ww105 (between 0 and 20 years), profession of woman denoted www206 (decomposed into 6 modalities: 1-worker, 2-specialized worker, 3- trader, 4-middle qualified skills, 5- high qualified skills, 6- liberal professional), participation of woman in expenditures Household denoted www210 (decomposed in 5 modalities: 1 – almost nothing, 2 – less than half, 3 – almost half, 4 – more than half, 5 - all expenses), woman fathers job denoted ww310 (same modalities of the variable www206), woman mother’s job denoted ww311 (same modalities of the variable www206), husband’s age noted ww609 (varied between 22 and 98 years), number of years of schooling of husband denoted ww602 (range in 0 to 20years), profession of man denoted www607 (same modalities of the variable www206), husband's participation in household product denoted “parhom” (in our case the product of the household is the quality of children, the variable “parhom” is determined by the degree of participation of husband in each of these tasks: education of children (in term of time), punishment of children and child health. Therefore, the variable parhom obtained is decomposed into three modalities: 1

\[\varepsilon_2 \] is a random disturbance, assumed to be normally distributed with mean zero and variance one.
–almost nothing, 2 – sometimes 3 - always). For couples without children, we assume that parhom = 3) and the milieu variable denoted by wmili1 = 1 if the area is urban and "0" otherwise.

Before estimate the strategic model of our decision process, we use the simple probit model to our data. The principal result derived from the probit estimates is that the woman expects that the financial side is the main factor that explains the refusal of the husband’s decision to quit job. From these estimates, we retain the pertinent variables in explaining the labor supply of married women to use in the strategic estimate.

### 4.2. Strategic estimate results

The estimation of married-women labor supply process via a strategic approach is possible after making modifications in the structural equation of traditional models to introduce the expected utility instead of the simple utility. We used Eviews 5.1, after making the necessary changes\(^\text{14}\). The results obtained are given in this table

<table>
<thead>
<tr>
<th>Variables</th>
<th>Woman model</th>
<th>Man model</th>
</tr>
</thead>
<tbody>
<tr>
<td>w103c</td>
<td>-0.168***</td>
<td>0.008</td>
</tr>
<tr>
<td>ww109</td>
<td>1.115*</td>
<td>0.031</td>
</tr>
<tr>
<td>www 105</td>
<td>-0.183**</td>
<td>0.026*</td>
</tr>
<tr>
<td>www 206</td>
<td>-1.135***</td>
<td>-0.078**</td>
</tr>
<tr>
<td>www607</td>
<td>0.720***</td>
<td>0.343***</td>
</tr>
<tr>
<td>Parhom1</td>
<td>0.225</td>
<td>1.762***</td>
</tr>
</tbody>
</table>

From this table, we find that:

(i) Coefficients of the number of children (ww109) and the husband’s household product participation (Parhom) have the same sign. That result has been initially expected is expected result since the woman anticipates the existence of positive effects of these two variables implemented in husband’s model. The woman, once she gives up her job, she will try to convince the husband by his decision based on the quality of children (she will more take care of children). (ii) The negativity of parameters of woman’s education level and of his profession means that these variables discouraged the woman gave up her job. (iii) Coefficient of the variable ww109 is shown here (in contrast the probit model) as a dominant variable on the decisions of actors in this model. This is due to the implementation of wife’s - in his model- anticipation

\(^{14}\) We can use directly the STRAT logiciel, See Signorino 2003.
of her husband’s reaction. (iv) The quality of children’s interests as the men and even compensates the negative effect of the woman income on her husband’s decision.

The woman can then predict factors that contribute to the refusal of her husband. Here, the financial side cannot be a factor for refusal, contrary to what she provides in the probit model but the quality of children account more for both partners.

5. Conclusion

In this paper, we tried to model; through a strategic approach, the decision-making process of married-women labor supply in Tunisia taking into account the effect of strategic interaction between the decisions of both player (this modeling is valid for any other strategic discrete-choice process). Based on the terminology of game theory, we presented the decision process of women labor supply with an extensive tree. However, after specified limits of traditional models in analyzing such a decision in the presence of strategic interaction. We have shown from the structural equation of strategic model that this model highlights the effect of the presence of strategic interaction. The implementation of the strategic model with Tunisian data, allowed us to deduce that - contrary to what the woman provide- the financial side is not a decisive factor in the reaction of the husband, after his wife gave up her job.

Husbands are more interested in the quality of their children. Therefore, we can say that the structure of the strategic model, contrary to that traditional models, taking into account the effect of the presence of strategic interaction between players of the game.

References

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