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Conceptual Paper

A Survey on Behavioral Models of Intra-Household Consumption

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Abstract

In the theory of microeconomics, in discussions related to consumer behavior, it is usually assumed that the household acts as a decision-making unit like an individual, and for a household, a budget constraint and a utility function are considered. As a result, only the general behavior of the household will be observable and analyzed. Since the 1980s, this method, which is called the Unitary Household Model, has been criticized theoretically and empirically, and issues such as the inequality of household members have been raised. In contrast to the Unitary Household model, Collective Household Model was proposed in consumer behavior. According to this method, in multi-member households, each member has their own preferences, and what can be important between these members is the intra-household bargaining process. In this article, at first, we will give an introduction including the theoretical foundation and the background of the research, then, while introducing the unitary model as an introduction to collective models, we will examine the collective model and inta-household collective models. At the end, the contents are summarized and suggestions for future research are presented.

Keywords: Unitary Household Model, Collective Household Model, Household Bargaining, Intra-household Allocation, Consumption behavior, Labor Supply.

Jel Classification: D13, C61, D70

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Introduction

Samuelson (1947) in the book of "Foundation of Economic Analysis" begins the chapter on the theory of consumer behavior by mentioning that if we want to distinguish modern economics from classical economics, it is necessary to examine the individualism theory of value. In fact, one of the outstanding features of the traditional microeconomics theory is the assumption of rational preferences, which determine the individual's behavior by including his/her tastes and interests. It is also assumed that the individual's preferences are represented by a constant utility function, and the problem of consumer choice is based on maximizing this utility function and also taking into account the budget constraint, determining the individual's set of options in the selection method, can be solved using the Slutsky Matrix on the demand function.

What Deaton and Muellbauer (1980) and Barten and Bohm (1982) proposed was that they considered the behavior of the household as the behavior of a consumer, and regarding household consumption and labor supply, the behavior of a multi-member household is considered the same as the behavior of a single-member one. These researches and similar to them indicate that in the mainstream economy, a household with several members was considered as a decision-making unit, and as a result, household consumption and labor supply was obtained according to the problem of maximizing the household's preferences, which was considered fixed, and the constraint of the budget. This model is called Unitary Model.

The Unitary Model lost its credibility due to the issues related to welfare economics and economic methodology (Vermeulen, 2002). Considering that the household is a group of people who each have their own preferences and making decisions among household members is obvious; The distinction between individual preferences and household preferences will change the behavior model of the household. What can be seen in the theory of conventional consumer behavior is that the behavioral foundations of a consumer and manager or household leader are considered the same, and as a result, the unitary model was approved. But due to the changes in the modern world, this model is not accepted now. In fact, a household is a small community that includes a number of people and each of these people has their own rational preferences. According to rational preferences and Arrow's impossibility theorem, the behavior of a group of people is not necessarily the same as an individual. One of the constraints of the unitary model is that the non-labor income of the household members is considered as the non- labor income of a one-person household. The income pooling hypothesis indicates that the source of this type of income does not play a role in the allocation of labor supply and consumption among household members, while this stipulation has been rejected in empirical studies (Lundberg et al., 1997). The second flaw of this model is related to the symmetry of the Slutsky matrix, for example, in which the effect of the final compensatory wage on labor supply is the same for two members of the household, which has also been empirically rejected (Fortin and Lacroix, 1997; Browning and Chiappori, 1998).

According to the mentioned cases, the unitary model is not able to determine the way of allocating the consumption and supply of labor among household members without considering stronger assumptions, and as a result, it cannot provide a correct analysis in the field of household members' well-being. Conventional economic models of well-

being consider only the distribution of well-being on the household, and the intra-household well-being of people is not important from this point of view (Bourguignon et al.,2009). For example, Apps and Rees (1996) showed that considering the welfare effects of tax changes, distributional effects among household members cannot be neglected in general. Knowledge about the decision-making process among household members is very important in many cases, including in programs that classify people into certain groups (such as women's groups or children's groups). Samuelson (1954) and Becker (1974) were the first people who stated that the household consists of people who each have their own preferences. By presenting his structure on the household decision problem, Samuelson showed that the utility function of the household cannot be presented with a unitary model. Becker also considered a head for each household in his model, which includes the preferences of all members of the household. Two other methods that consider all household members as decision makers use game theory means. The first method includes a model in which household behavior is considered in a Non-cooperative framework. In this model, each household member maximizes his own utility by assuming the behavior of other household members. In these types of models, the constraints that balance the household's behavior are different from the constraints that the unitary model imposes on the household. One of the drawbacks of non-communal models is that they do not necessarily meet Pareto's efficiency conditions in allocations related to household members. The second method was presented by Manser and Brown (1980) and McElroy and Horney (1990). They applied the means of cooperative game theory or in other words the principles of bargaining theory in the household model. In this model, household members are considered as economic agents who discuss and negotiate how to share the benefits of cooperation (living together), and depending on the bargaining power of the household members, a certain type of Pareto efficient allocation among the members is obtained in terms of welfare.

Donni (2003) developed a collective labor supply model based on nonlinear budget constraints. In this testability model, the certainty of the results was obtained without any contradictions.

Dercon and Krishnan (2000) related the collective household model to the principles of consumption homogenization and risk sharing. They used panel data from Ethiopia and showed that under uncertain conditions, the assumption of Pareto's efficiency related to household allocations requires income shock integration.

The collective model shows that household preferences depend on individual wages, prices, and non-labor income. In this model, the problem related to the Slutsky matrix and the hypothesis related to income sharing has been solved and the distribution of bargaining power in the household is dependent on the level of each of the mentioned variables.

With these explanations, the collective model has been accepted in modern microeconomics and economists such as and Browning and Chiappori (1998) have tried to expand this model.

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Analysis framework

In this part, we first take a brief look at the unitary model, and then the general collective household model presented by Browning and Chiappori (1998) is examined. This model includes leisure time, which is considered against labor supply.

The Unitary Model as an introduction to the Collective Household Model

The basic assumption of the unique method of household behavior is that its needs and desires are determined by rational preferences related to consumption and leisure bundles. These preferences are monotonic in ascending order. The form of the utility function of a household that includes two people who can enter the labor market in terms of age is as follows:

$$u = u(\boldsymbol{q}, q_0^A, q_0^B)$$

The utility function u is strictly pseudo-concave, continuously ascending and differentiable.

The vector $q=(q_1 \ldots . q_n) \in R^n_+$ represents the consumption vector of the household and the amount of free time of the individual is determined as q_0^A and q_0^B. The budget requirement of a household of two is defined as follows:

$$\boldsymbol{p}q + w^A q_0^A + w^B q_0^B \leq y^A + y^B + y^H + w^A T + w^B T$$

In this expression, the price vector is $p=(p_1 \ldots . p_n) \in R^n_{++}$, w^I is the wage rate of the household members and I (I= A, B) represents the household members. We also denote the non-labor income of individual I by y^I.

Y^H is the household's non-labor income that cannot be allocated to a specific person in the household and T represents time.

By using the maximization method in the following function, the selected package of the household is obtained:

max u(q̃)

Subject to:

$$\tilde{\mathbf{p}}\tilde{q} \leq y^s + w^A T + w^B T$$

$\tilde{q} = (q, q_0^A, q_0^B)$ represents the consumption and leisure of the household, $\tilde{\mathbf{p}}=(p, w^A, w^B)$ is the price vector and $y^s = y^A + y^B + y^H$ shows the total non-labor income of the household.

In this case we have:

$$\tilde{q}=g(y^s + w^A T + w^B T, \tilde{p}) \qquad (1.1)$$

The obtained demand functions have the properties of additive, homogeneity and symmetry of the Slutsky matrix. Apart from the collectability condition, other properties have been rejected in various studies (Deaton and Muellbauer, 1980).

In addition to the constraints and theoretical constraints that exist on the demand function, the unitary model implies the hypothesis of income integration, which indicates that the source of non-labor income does not play a role in determining the allocation method in the household. This issue is quite evident according to equation (1.1), because the final changes of different non-labor incomes have the same effect on demand, i.e.:

$$\frac{\partial g}{\partial y^A} = \frac{\partial g}{\partial y^B} = \frac{\partial g}{\partial y^H} = \frac{\partial g}{\partial y^s}$$

which has also been rejected in many cases (browning et al., 1994; Fortin and Lacroix, 1997; Browning et al. 2010).

The rejection of the hypothesis of income integration caused the theory of consumer behavior to be revised again. This revision was to pay attention to the fact that households are made up of different people, each of whom has their own preferences, and the decision-making process takes place among household members.

Examining General collective household model

We continue the discussion by considering the same household that includes two members of working age. In contrast to the unitary model, we have the collective model of the household, in which each person has his own rational preferences. These preferences are defined on the individual's consumption and leisure as well as the consumption and leisure of another person. Therefore, external factors are effective on a person's consumption and leisure. These external factors can have a positive or negative effect. There are no restrictions on goods here. Goods can be consumed privately or publicly or both.

Preferences of individual I; (I=A,B) is presented in the form of the following utility function:

$$U^I = u^I(q^A, q^B, q_0{}^A, q_0{}^B, Q)$$

U^I is a strictly concave, continuously ascending and differentiable utility function. Consumption vectors are $q^A=(q_1{}^A\ldots,q^A{}_n)$ and $q^B=(q_1{}^B,\ldots,q_n{}^B)$. The values of $q_0{}^A$ and $q_0{}^B$ both represent leisure values. The general consumption vector is $Q= (Q_1,\ldots,Q_n)$. Since we included external factors in this function and these factors can have a positive or negative effect, in cases where $J \neq I$, u^I will not necessarily increase in q^J. The household budget is as follows:

$$p(q^A + q^B + Q) + w^A q_0{}^A + w^B q_0{}^B \leq y^A + y^B + y^H + (w^A + w^B)T$$

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When a household makes a purchase, that purchase is the result of the decision-making process among the members of that household, and many models have been presented in this regard. For example, Manser and Brown (1980) as well as McElroy and Horney (1990) followed a bargaining method in their model and their assumption was that the behavior of the household follows specific bargaining rules related to the Nash and Kalai-Smorodinsky method (Bourguignon et al., 2009; Browning et al., 1994; Chen and woolley, 2001; Chiappori et al., 2011). Browning and Chiappori (1998) provided arguments for the collective household model. First, in a repeatable game and assuming complete information on the preferences of household members, it is possible that household members can develop a Pareto efficient allocation mechanism. Secondly, it can be said that the Pareto's efficiency of the general state is the assumption of maximization of utility in the unitary model, considering multi-member households. In many bargaining laws, the assumption of Pareto's efficiency is considered as the basic assumption in general. For example, we can mention the methods of Nash and Kalai-Smorodinsky, utilitarian and egalitarians (Thomas, 1990). $(q^A,q^B,q^A{}_0,q_0{}^B,Q)$ will be a Pareto optimal allocation of consumption and leisure in a household if this allocation is obtained by maximizing the following function:

$$\max \; u^A(q^A,q^B,q_0{}^A,q_0{}^B,Q) \qquad (2.1)$$

Subject to:

$$U^B(q^A,q^B,q_0{}^A,q_0{}^B,Q) \geq \bar{u}^B$$

$$p'q+w^Aq_0{}^A+w^Bq_0{}^B \leq y^s+(w^A+w^B)T$$

According to the above relation u^{-B} is the level of utility required for person B and $y^s=y^A+y^B+y^H$ and $q=q^A+q^B+Q$. Therefore, the maximization problem (2.1) seeks to find an allocation that maximizes the welfare of individual A according to the level of welfare allocated to individual B and the constraints of the household budget. By changing the utility level of individual B, all Pareto efficient allocations are obtained. This set of Pareto efficient allocations forms the utility possibilities frontier and represents all the vectors of the attainable utility levels of the household. Since individual utility functions are strictly concave and the budget constraint presents a convex set, all Pareto efficient allocations are characterized as stationary points on a linear social welfare function (Mas-Colell et al., 1995).

The solution to problem (2.1) will be as follows:

$$\text{Max} \;\; \mu(p,w,y)\, u^A(q^A,q^B,q_0{}^A,q_0{}^B,Q) + [1-\mu(p,w,y)]u^B(q^A,q^B,q_0{}^A,q_0{}^B,Q) \qquad (2.2)$$

So that:

$$p'q+ w^Aq_0{}^A+w^Bq_0{}^B \leq y^s+(w^A+w^B)T$$

In the above social welfare function, weight coefficients μ(p,w,y) and 1-μ(p,w,y) are related to both household members. In the general case, the Lagrangian coefficients of the maximization relation (2.1) depend on the exogenous variables w,p,y. These coefficients show the bargaining power of household members in the intra-household allocation process. Changes in wages, non-labor income and prices can change the bargaining power from one person to another, which will result in changes in the consumption and supply of labor. For example, a change in the non-labor income of a household member will not only affect the consumption and supply of household labor through the income effect, but will also affect the bargaining power.

Since the changes in non-labor income of the individual change the bargaining situation of household members, the source of non-labor income is very important to determine the allocations related to household members, which is one of the important arguments of the collective household model and rejects the hypothesis of income integration in the unitary model. Such a conclusion is also true for changes in wages and prices, as a result of these changes, apart from the substitution and income effects, the transfer of bargaining power to household members is not far from expected. According to the relationship (2.2), household preferences indicate that the Slutsky matrix does not always remain symmetric and is not necessarily negative semi-definite, which is one of the important results of the collective model. The weighting coefficients in relation (2.2) can be changed according to changes in wages, non-labor income and prices, and as a result, household preferences do not remain constant for a long time, and the probability that preferences remain rational, complete and transferable is low. So it cannot be expected that the consumption and supply of household labor will remain stable. While in the unitary model, according to the rationality of preferences, the stability of consumption and supply of labor was not far from expected. The question raised here is that under what conditions does the collective household model become a unitary model using the relationship (2.2)?

There are three ways to achieve this goal: The first possible way is to consider the preferences of the household as the preferences of the household leader or planner (Cherchye et al. 2011). This method is obtained in the condition that the welfare weight coefficient of person A, i.e. μ(p,w,y) of the constant form, is equal to one or zero. In this method, which is known as the dictator method, if the coefficient is one, individual A will be the determining individual (dictator) and if it is zero, he will be a member of the household (B).

It should be noted that a dictator can be a caring person who optimistically determines and evaluates the consumption and leisure of other household members. In this situation, the dictator's individual's utility function $u^I(q^A,q^B,q_0{}^A,q_0{}^B,Q)$ will be upward, in other words, external factors have only a positive effect.

In the second method, the weight coefficient of people's well-being is a fixed number between zero and one. In this case, the individual's utility function is equal to (Blundell and Robin, 2000):

$$\mu\, u^A(q^A,q^B,q_0{}^A,q_0{}^B,Q) + (1-\mu)]u^B(q^A,q^B,q_0{}^A,q_0{}^B,Q)$$

The third way to convert the collective household model into a unitary model is that the preferences of both household members are the same preferences on consumption and leisure, in which case the total utility function will be equal to the utility function of both individuals.

Now, by entering an assumption on equation (2.2), the concept of collective household model can be tested. We assume that the function μ(p,w,y) is a continuous, differentiable and homogeneous function of degree zero. This assumption leads us to a unique solution for the maximization function of the utility function. The second assumption is that only the overall consumption of the household can be seen, that is: $q=q^A+q^B+Q$.

According to the unitary model:

$$\tilde{\mathbf{p}}=(p,w^A,w^B) \text{ and } \tilde{\mathbf{q}}=(q,q_0{}^A,q_0{}^B)$$

Considering two different wages and Pareto's efficiency, household allocation is obtained using the equation (2.2):

$$\tilde{\mathbf{q}}=g(y^s+w^AT+w^BT,\tilde{p}) \qquad (2.3)$$

In this regard, the vector q̃ for all goods is equal to: $\tilde{\mathbf{q}}_i=q_i{}^A+q_i{}^B+Q_i$.

According to the above assumptions, the demand functions are continuous, differentiable and homogeneous from degree zero, and the total income is as follows:

$$Y= y^s+ w^AT+w^BT$$

According to the observable demand functions, the Slutsky matrix will be in the following form:

$$S=\frac{\partial g}{\partial \tilde{p}} + [\partial g/\partial(y^s + w^AT + w^BT)]\tilde{q} \qquad (2.4)$$

This relation is known as pseudo-Slutsky matrix.

Browning and Chiappori (1998) showed that the household demand function that is consistent with the collective model can be expressed by the following expression:

$$S = \sum + uv' \quad (2.5)$$

where the rank of the matrix $R=uv'$ is at most one and $\sum$ is a negative semi-definite symmetric matrix.

Extension of the general model with distribution factors

In the previous sections, it was explained that the weight coefficients related to welfare in the household's utility function, which actually represent the bargaining power of household members, are dependent on prices, wages, and non-labor income. In Browning and Chiappori 's model (1998), it was shown that prices and wages play an important role

in this. But, other factors also affect the allocation process. For example, an increase in a person's non-labor income can transfer bargaining power from one person to another, which is effective in allocating the consumption and supply of household labor. Other factors, such as environmental parameters outside the household, such as divorce laws, tax laws, etc., affect the bargaining power of people, but their effect is not so clear. Browning et al. (1994) call such factors as distributional factors. Distributional factors are variables that affect μ or bargaining power, but do not have a direct effect on individual preferences and household budget constraints, such as individual non-labor incomes. Browning and Chiappori 's model (1998) showed that the collective household model is also obtained through a distributed factor Z. In this case, the pseudo-Slutsky matrix becomes the following form:

$$S=\sum +\frac{\partial g}{\partial z} v'$$

This relationship shows that the final change in the distribution factor z is directly related to the pseudo Slutsky matrix S and the normal symmetric Slutsky matrix ∑. With the use and careful selection of distribution factors, the collective household model cannot be rejected (Browning and Chiappori, 1998).

Constraints of the general collective household model

The model that we considered so far as a collective household model was a general model in which we did not include any constraints on individual preferences. We saw that in this model, both external factors and public goods were allowed to enter individual utility functions. The obtained arguments could also be expressed according to price changes. Now we want to limit the general collective household model. By limiting individual preferences, the way of allocation among household members will be clearer and more specific. In addition to preference constraints, available data sets can impose additional constraints on the general model. For example, in the household budget, the wages and working hours of each person are not specified separately.

Constraints related to preferences and examination of the distribution rule

1. Egoistic Preferences and Caring Preferences

So far, we have assumed that people's preferences are represented by the utility function u^I (q^A,q^B,$q_0{}^A$,$q_0{}^B$,Q) (I= A, B). We know that external factors can change consumption and leisure with positive and negative effects. Here, to limit the preferences, we only consider egoistic preferences and caring preferences. People have egoistic preferences if their preferences depend only on their consumption and leisure, and it is defined in the following form:

$$U^I=u^I(q^I,q^I{}_0) \qquad I=A,B$$

In this type of preferences, the change in the individual's consumption and leisure has no effect on the well-being of the individual. Caring preferences are also defined in the following form:

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$$U^I=f^I(u^A(q^A,q_0{}^A),u^B(q^B,q_0{}^B)) \qquad I=A,B$$

The f^I function is an ascending function. Caring preferences are defined as household members determine and evaluate the well-being of other people in a positive way, in other words, each household member seeks to optimize the utility function of the entire household, because in this way, the utility of all household members increases. These types of preferences, in addition to considering the relationship of friendship, affection and benevolence that actually exists between household members, also show the degree of cooperation between household members (Cherchye et al., 2010).

2. Sharing rule

Assuming the existence of egoistic or caring preferences, the Pareto efficient allocation of the household of equation (2.2) will be in the form of function Φ (p,w,y) where the amount of leisure of individuals $q_0{}^A$ and $q_0{}^B$ and their consumption i.e. q^A and q^B will be obtained from the maximization of the following function:

$$\text{Max} \quad u^I(\mathbf{q}^I,q_0{}^I) \qquad (2.6)$$

Subject to:

$$pq + w^I q_0{}^I \leq \Phi^I(p,w,y) + w^I T$$

in this relationship, $\Phi^A(p,w,y)=\Phi(p,w,y)$ and $\Phi^B(p,w,y) = y^s - \Phi(p,w,y)$.

Φ is the distribution law according to which, y^s is the total non-labor income of the household which is divided between both household members and depends on exogenous prices, wages and non-labor income. According to this rule, people independently allocate their share of income to consumption and leisure in a way that maximizes individual well-being.

The distribution rule, which expresses the Pareto's efficiency of household behavior, is actually the application of the second fundamental theory of welfare economics. The sharing rule and its results are fruitful in determining individual preferences and the allocation process among household members.

Collective labor supply models

1. Collective labor supply with observable distribution factors

Many data sets that include labor supply data (wages and working hours) do not include household consumption information. In microeconomic data, the only information related to price changes is the difference in wages between individuals. Since there is no information about the relative price changes related to the consumption of goods at different stages, we can only rely on Hicks' composite commodity theorem. According to this theory, if a group of prices change in parallel, the consumption behavior of the commodities corresponding to those prices will be as a single commodity, which is called the Hicksian aggregate commodity (Deaton and Muellbauer, 1980).

One of the assumptions here is that what are considered as sources of relative price change are the wages of both household members. Another assumption is related to preferences that we consider individual preferences as egoistic. The third assumption is to consider at least one observable distribution factor z, which is different from people's non-labor incomes. According to this assumption, equation (2.5) is as follows:

$$\text{Max} \quad \mu(w,y,z)\, u^A(c^A,q_0^A) + [1-\mu(w,y,z)]\, u^B(c^B,q_0^B) \qquad (2.7)$$

Such that

$$C^A + c^B + w^A q_0^A + w^B q_0^B \leq y^s + (w^A + w^B)T$$

Here, c^I is individual I's unobservable consumption of the Hicksian aggregate commodity, and z is the distribution factor that affects only the functions 1-μ and μ. The price of Hicksian commodity is assumed to be equal to one. By solving the above equation, we will have:

$$L^I = h^I(y^s,w,z) \qquad (2.8)$$

This relationship shows that labor supply equations depend on non-labor income, wages and distribution factor. According to the assumption of egoistic preferences, we have:

$$L^A = l^A(\Phi(w,y,z),w^A)$$
$$L^B = l^B(y^s-\Phi(w,y,z),w^B) \qquad (2.9)$$

In these relationships, Φ is the distribution rule and determines the allocation process among household members. These equations also show the constraints of the collective model on the observed labor supply behavior. According to the relation (2.9), the final changes in the distribution factor z affect only the supply of labor i.e. l^A and l^B through the distribution rule. Also, the final change in the salary of a household member only has an income effect on the labor supply of another person, and the final changes in non-labor incomes have an indirect effect on the labor supply. Considering these cases, the final rates of substitution between each pair of variables in the set $\{w^A,w^B,y^A,y^B,y^H,z\}$ are obtained. Having this set of final substitution rates, the partial derivative of the distribution rule is obtained. What can be considered as the result of the distribution rule is that if all the conditions are met, the distribution rule is determined as a constant addable number.

2. Collective labor supply without observable distribution factors

Here we want to apply more constraints. Unlike the previous part, in this part we assume that only the individual wages of both household members and the total non-labor household income are observable. This work was done by Chiappori (1992). According to the mentioned cases, the collective model of the household is as follows:

$$\text{Max} \quad \mu(w,y^s)\, u^A(c^A,q_0^A) + [1-\mu(w,y^s)]\, u^B(c^B,q_0^B) \qquad (2.10)$$

Such that: $C^A + c^B + w^A q_0^A + w^B q_0^B \leq y^s + (w^A + w^B)T$

As we know, y^s represents the total non-labor household income. According to the solution of this problem, the set of labor supply functions is obtained, in which non-labor income and wages can be seen. Also, considering the assumption of egoistic or caring preferences, individual labor supply can be written as the individual's own wage rate and his share of non-labor income. Chiappori derived a set of testable constraints on the collective model on the observable labor supply. This constraint was tested by Fortin and Lacroix (1997). They concluded that the constraints related to the unitary model are strongly rejected, while the collective model cannot be rejected in some circumstances. So far, our assumption has been based on the fact that we only have labor supply information in our dataset. Therefore, consumption information is limited to Hicksian aggregate commodity consumption only. According to the studies related to the household budget, there is detailed information about the allocation of household expenses for different commodities, while there is no information about labor supply and wages in many cases. If we assume that the supply of labor is constant, i.e. both household members work a certain amount of hours (it can be zero), then the exogenous income is considered and will be included in the equation as a total. Also, as is usual in household budget research, we do not consider relative price changes. By considering individual consumption preferences in a egoistic or caring way, we have the possibility to use the distribution rule to obtain testable arguments in this collective model and obtain decisive results. Another assumption that we consider in this model is that at least one commodity demanded by the individual is observable and there is also at least one observable distribution commodity.

By introducing this assumption to the new maximization problem, which leads to the allocation of expenses to the private commodity demanded by the individual in a Pareto efficient manner, the general model of equation (2.2) is summarized in the following form:

$$\text{Max} \quad \mu(x,z)u^A(q^A)+[1-\mu(x,z)\,u^B(q^B)] \qquad (2.11)$$

Subject to:

$$\dot{l}(q^A+q^B) \leq x$$

Here, q^I is the consumption vector of individual I, and I is a vector that contains a column of one because we assumed the prices of commodities to be equal to one, z is the observable distribution factor, and x is the total household expenditure. Weight coefficients related to bargaining power are generally dependent on x, and x is an exogenous variable. Due to the fact that the demand of individuals A and B for commodity 1 is assumed to be observable in the form of q_1^A and q_1^B, solving the problem with the maximization method leads to the following solution, which are the same Engel's curves:

$$q_1^A = g_1^A(x,z) \qquad (2.12)$$
$$q_1^B = g_1^B(x,z)$$
$$\tilde{q} = \tilde{g}(x,z)$$
$$\tilde{q} = (q_2^A+q_2^B,\ldots,q_n^A+q_n^B)$$

In this regard, q̃ is the observed demand of the household for the consumption of commodities, and individual consumption cannot be identified. Considering that individual preferences can be egoistic or caring, the distribution rule can be used again. According to the share of expenses of individual A and B from the total expenses of the household, i.e. x-Φ(x,z) and Φ(x,z), Engel's curves related to commodity 1 can be written as following:

$$q_1^A = f_1^A(\Phi(x,z)) \qquad (2.13)$$
$$q_1^B = f_1^B(x-\Phi(x,z))$$

By using the four partial derivatives of these equations, the final substitution rates of Φ can be obtained through which the partial derivatives of the distribution rule are obtained and the expression of the collective model is as follows:

$$\frac{\partial^2 \Phi}{\partial x \partial z} = \frac{\partial^2 \Phi}{\partial z \partial x}$$

The following results are obtained according to the above constraints:

1. The division rule is determined as a fixed addable number.

2. Individual shares in expenses on private commodities can be obtained by determining the rule of distribution which will also be a fixed addable number. According to Browning et al. (1994) research on the budget of Canadian households, the difference in age and income of both household members, as well as the expenses of the whole household, have a statistically significant effect on the sharing rule, and the constraints of the collective household model cannot be rejected.

Bargaining principles and cooperative models

So far, in collective household models, we only considered the Pareto's efficiency condition for allocations among household members. The utility possibilities frontier includes the infinite Pareto efficient allocation. By introducing other principles in addition to Pareto's efficiency, other results of household behavior can be obtained. Manser and Brown (1980) obtained empirical arguments for bargaining solutions such as the dictator solution, the Nash solution, and the Kalai-Smorodinsky solution. McElroy and Horney (1990) also studied the Nash solution and the generalization of Slutsky symmetry. The Nash solution is obtained according to the cardinal information and there is no need to compare the preferences between individuals. The behavior of the household according to these principles follows the following equation:

$$\max [u^A(q^A,q^B,q_0^A,q_0^B,Q) - \tilde{u}^A][u^B(q^A,q^B,q_0^A,q_0^B,Q) - \tilde{u}^B] \qquad (2.14)$$

subject to:

$$p'q+w^Aq_0^A+w^Bq_0^B \leq y^s+(w^A+w^B)T$$

In this equation, $\tilde{u}^I$ is the Threat point or disagreement point of individual I. This answer is related to the time when collective agreement is not reached. Therefore, the Nash solution provides a solution that maximizes the results of cooperation according to the constraints of the household budget. In order to apply the Nash bargaining method, the threat points must be defined correctly, but it is not clear which threat point should be chosen.. McElroy and Horney (1990) derived threat points from labor supply and consumption data of divorced individuals. With this method, consumption and labor supply of multi-person household can be obtained through the estimated threat points. Any variable that is expected to affect the threat points is included in the analysis. In fact, these variables are effective on the bargaining power of people and affect the selected Pareto efficient allocation.

Non- cooperative Household Models

In examining the models related to the household, we come across a model in which several decision makers are included in the household. These types of models are based on non-cooperative game theory. In this type of non-cooperative models, it is assumed that household members maximize their utility based on a person's budget, and the individual behavior of other members is considered given. One of the distinctive characteristics of this type of model is that the allocations between household members are not necessarily Pareto efficient. But, this depends on how the dependence of individual in the household is defined.

Early research on the non-cooperative model was provided by Leuthold, (Ashworth and Ulph, 1981). In their labor supply model, individuals allocated total income to their leisure and consumption of Hicksian commodity, which was assumed to be a public good. This model takes into account the effects of external factors in people's leisure and includes more behavioral constraints than the unitary model. But in this model and similar models, Pareto efficiency is not considered in allocations among household members. Non-cooperative consumption models also have the mentioned characteristics. For example, the non-cooperative consumption models presented by Chen and Woolley (2001) and Cherchye et al. (2010) are of this type. In general, these models provide Pareto inefficient allocations among household members. Assuming the integration of income or when we consider the preferences of the household as caring, the distribution of income among household members has no effect on the allocation of consumption among them.

According to the Pareto inefficient allocation in these types of models, it is possible to obtain the saving behavior and the selection of the household's portfolio. Household members can obtain the utility related to the current and future consumption of the household's general good by using the Nash equilibrium.

Conclusion

Theoretical models related to the household are classified into two categories: unitary model and collective model. The collective models themselves are divided into two categories: cooperative models and non-cooperative models. The results of cooperative models are always Pareto efficient, while in non-cooperative models this feature is not always present.

According to the experimental tests, the distinctive feature of the unitary model, which is the integration of income, was not accepted. The collective model in household behavior is a suitable alternative to the unitary model. In the unitary model, it is assumed that households act as a single decision-making unit. On the other hand, the collective model considers the household to consist of members who each have their own preferences and the bargaining process occurs among these members. This process can have different forms, for example, the collective model presented by Chiappori (1992) considers bargaining between household members as a result of Pareto efficient allocation of resources in the household.

Due to the greater advantages of the collective model than the unitary model, this model became the beginning of many social theories such as the theory of social welfare, and since it considers individual preferences, it bases its work on the methodological principles of individualism. The assumption of Pareto efficiency regarding household decisions in these types of models leads to the creation of observable allocations of the household in such a way that it has the ability to be tested and rejected as well as determinable. Another advantage of collective models is that they explain the intra-household distribution of resources, which was neglected in the unitary model. By using the collective model, it is possible to obtain the changes in the share of the household members from the resources according to the changes in the economic environment. What can be emphasized about these models is that their study can be useful in the evaluation of policies, in other words, if policy makers want to adopt a policy regarding health and happiness and individual well-being, considering the household as a single unit (without considering the preferences of household members) is insufficient and will lead to wrong decision.

According to the experimental and theoretical evidence in various studies, Pareto efficiency can change from time to time or by changing the location or geographic location, and In fact, there is a need to dynamically examine the collective model of the household and the factors affecting the decision-making process in the household over time and Intertemporal space. This requires more complex research that is beyond the scope of this article. Also, due to the multiplicity of types of households, more studies should be done in this field, which types of households can be analyzed using the unitary model and which ones should be analyzed using the collective model, and in other words, which types of households can be included in the Pareto efficiency of collective models. Mentioning these things can pave the way for future studies and research.

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