Unitary or Collective Models? Theoretical Insights and Preliminary Evidence from Peru*

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Resumen

El presente documento ofrece una discusión teórica acerca de los modelos de hogares de decisión colectiva. Estos modelos, en contraste, con los modelos unitarios consideran que las decisiones de consumo de las familias son el resultado de un proceso de negociación e interacción de los miembros. Luego, las condiciones de equilibrio predichas por el enfoque colectivo podrían diferir de aquellas que se obtienen del enfoque tradicional de maximización de utilidad. El interés del documento se centra en dos elementos específicos: la emergencia de la hipótesis de utilización conjunta de los ingresos (lo que caracteriza a los modelos unitarios) y de la hipótesis de eficiencia en la asignación de recursos (lo que caracteriza, entre los modelos colectivos, a aquellos con solución cooperativa). A través de estas características, el artículo propone una serie de pruebas preliminares para validar el enfoque colectivo de maximización de utilidad usando datos para el Perú y luego investiga si es que se logra eficiencia en las decisiones de consumo. Los resultados ofrecen nuevos detalles acerca del comportamiento del consumidor peruano.

Palabras clave: Decisiones de consumo familiar, asignación de recursos, maximización de utilidad.
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Abstract

The document provides some theoretical insights around collective models of household decision making and resource allocation. These models, in contrast with unitary ones, consider the consumption decisions of the family to be a

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result of a bargaining process and interaction between household members. The predicted equilibrium conditions tend to differ from the traditional approach of utility maximization. The focus is centered on two specific issues: the emergence of the pooling income hypothesis (which characterizes unitary models) and the efficiency hypothesis (which characterizes, within the collective framework, cooperative solutions). Using these insights, the article establishes preliminary tests for the collective approach, as against the unitary one, using data for Peru, and then investigates whether efficiency is achieved in consumption allocation. The results presented provide new insights about consumption behavior in Peru.

Keywords: consumption decisions, bargaining process intra household, utility maximization, resource allocation
JEL Codes: D12 and D13

INTRODUCTION

The family, as it constitutes the nucleus of society, is conceived of as the fundamental unit for the formulation and implementation of social policies. However, it must be recognized that it does not always act as a homogeneous aggregation of people. Rather, it is better understood as a complex organization formed by individuals with different preferences that eventually need to bargain in order to secure their participation in the decision making process of the household. Given this observation, some economists influenced by sociological and anthropological insights into human behavior and based on the seminal contributions of Manser and Brown (1980) and McElroy and Horney (1981), have tried to validate the bargaining hypothesis of resource allocation within the family. The empirical evidence seems to give support to them, as reported by Lundberg and Pollak (1996), Haddad, et.al (1997) and Bardhan and Udry (1999).

The findings are of critical importance since the characteristics and determinants of the equilibria reached under this framework (collective models) tend to differ from the traditional approach (unitary models). Also, they help to improve our understanding of the resource allocation process within the family (allowing for efficient and inefficient outcomes) and amplify the scope of public policy interventions. For example, experiments undertaken by Hoddinott and Haddad (1995), Thomas (1997) and Phipps and Burton (1998) show that is possible to improve the consumption of «social desirable» goods via income transfers or empowerment among specific members of the family. The conclusion reached is that some members' expenditure (wives) is more pro-welfare than expenditure of other members (husbands), so increases in the resources controlled by them or enhancing their bargaining power will improve the social outcome for a given household income level.

Given these observations, the objective of the research is to validate or reject the collective models using Peruvian data. If validated, we can then examine whether or not efficiency is reached in the resultant resource allocation from the bargaining process. The conclusions obtained around these hypotheses will help to provide interesting insights about the consumption allocation of the households and the demand patterns in this developing country. In order to reach this objective, empirical tests discussed in Deaton (1997) are performed. However, given the nature of the tests proposed (non-linear Wald tests), some technical difficulties arise. As stated by Agüero (2007), these are mainly related to the high sensitivity of the Wald statistic to the mathematical expression of the null. Most of the studies encountered in the literature do not take proper account of these difficulties and their main conclusions give grounds for skepticism. In the present application, possible departures from the main conclusions are overcome, changing the mathematical expressions of the tests.

The rest of the document presented here is organized as follow. In section two the theoretical aspects of unitary and collective models are presented. Special emphasis is placed on the different approaches used to explain the emergence of the pooled and non-pooled income hypothesis of demand behavior and the implied assumption of Pareto efficiency of the predicted outcomes. In section three, following a simple and flexible Quadratic Expenditure System (QES) specification, the pooling and efficiency hypothesis are tested. Section four concludes the paper with some final thoughts on the general topic and the further research agenda.

1. THEORETICAL ASPECTS[1]

The theoretical terrain of consumer theory in microeconomic analysis has been explored through the process of individual maximization. However, in empirical terms most of the microeconomic analysis and policy recommendations are undertaken at the household level. An apparent paradox emerges here: the analytical unit on the theoretical side is different from the analytical unit researched empirically. The way that economists have sought to deal with this paradox is by establishing a relation between the individually based maximization process and the maximization process for the household overall. The explanations can be summarized in two different kinds of models: unitary and collective.

The idea behind the unitary models is that a household is assumed to act as one (Alderman, et.al. 1995). Then the household can be seen as the relevant economic unit and the preferences that it reveals provide a good summary or representation of the preferences of the individuals inside. As Lundberg and Pollak (1996) do this, it is possible to summarize this approach by considering two kinds of frameworks that provide theoretical support to the assumption made: the consensus model developed by Samuelson (1956) and the altruistic parents' model developed by Becker (1974). In the first instance, consensus arises because, even with different preferences, the family agrees to maximize an overall household utility function subject to a joint budget constraint. The implied assumption here is that preferences and incentives are such that consensus is possible across the household. However, this first approach does not specify how these conditions are attained and

1. It is important to note that the models developed here rest on two assumptions. First, consumption of commodities and labor supply are separable. Second, consumption and production decisions are separable. The first one allows to consider commodity groups purchases separable from leisure (this assumption is drop in the empirical application). The second one helps to solve utility maximization problems for consumption taking income as pre-determined or fixed; this means the adoption of a recursive approach for household modeling which will be probable a restrictive assumption for farm households (Singh *et al.* 1986).

maintained. This is the starting point for Becker's model. In this second framework, an altruistic agent (the parent) maximizes on behalf of the rest of members given the overall budget constraint of the family. To do this, he exploits a common utility function that reflects the preferences of each individual. Given the ability of the parent to make positive transfers to each individual, an unselfish behavior on the part of the members is secured even under the presence of selfish, but rational agents.

It is easy to see that the demand functions that these schools reach can be obtained by a maximization process of a unique utility function subject to a common budget constraint. Using the notation from Becker (1981) and Gravelle and Rees (2004), the problem can be expressed in the following way: consider a household formed by K members and an overall household utility W that can be expressed as being made up of the individual utilities of each member U_k as follows.

$$W = W[U_1(x_{1i};\lambda); U_2(x_{2i};\lambda);...; U_k(x_{ki};\lambda)] \quad (1)$$

Where X_{ji} represents consumption of good i (i=1,2....q)[2] made by individual j (j=1,2.....k) and λ is vector of household specific characteristics. The budget constraint faced by the household is of the form:

$$M = Y_o + \sum_{j=1}^{k} Y_j = \sum_{i=1}^{q} p_{1i}x_{1i} + \sum_{i=1}^{q} p_{2i}x_{2i} + ... + \sum_{i=1}^{q} p_{ki}x_{ki} \quad (2)$$

where M is the total income of the household that can be disaggregated in the particular incomes earned by each member Y_j and Y_0 which is any kind of income that is common to the household. The set p_i is made up of the market prices available for the household[3]. Once the maximization conditions are met, it is easy to derive the Marshallian demand functions for the household.

$$\sum_{j=1}^{k} x_{ji} = x_i^{\bullet} = x_i(p_1, p_2, ..., p_q, M; \lambda) \quad (3)$$

As noted by Lundberg and Pollak (1996), this optimization problem generates family demands that depend only upon prices and total family income and have standard

2. In general, goods can be private exclusive (only one member consume such items as clothes), private non-exclusive (any member can consume it separately, like food) or public goods (its consumption involves all members, like rent payments). In the present framework the vector comprises all categories.
3. Under plausible assumptions, similar goods have similar prices even if they are consumed by different members.

properties [Pareto optimality, among others], provided that the utility functions are well behaved. Thus, the traditional analytical framework of consumption analysis can be directly applied. This means that price and income elasticities can be derived at the household level based on the notion that this unity is the relevant maximization agent. This framework is useful (and broadly used in the literature) to analyze the different consumption patterns and policy responses regarding different family structures and family characteristics (see Bourguignon and Pereira, 2003 for some examples).

However, there are some problems in terms of both the empirical and theoretical bases for such models. The first one, consistently noted in the literature, is that the approach predicts that all resources of the household are pooled and commonly spent irrespective of the identity of the household members who control the income (or generate it). Then it is only the level of the income and not the distribution of it which influences the consumption patterns. Evidence tends to reject this prediction and it is consistently found that the distribution of income inside the household also influences consumption. Specifically, differences in the control over resources tend to affect the level of consumption of some goods and the final shape of the consumption bundle. A second criticism made of the model, pointed by Haddad et al. (1997), is that household behavior is still a «black box» and the question of how common actions come about is still not resolved.

The possible answers offered by the collective models to these theoretical and empirical questions have given them some popularity in the analysis of household allocation of resources. The framework used to derive the equilibrium on the consumption allocation is also based on the recognition of different agents inside the household that have different utility functions but, in contrast, the different theoretical approaches try to give insights about how the household can reconcile them (the maximization process is derived via assumptions on the type interaction among the members). Using this more general approach, unitary models are conceptualized as special cases and the theoretical approaches supporting them as providers of the conditions under which unitary behavior can arise.

In general, collective models can take at least two forms: cooperative bargaining models and non cooperative models[4]. The first of these can involve three frameworks: a sharing rule variant proposed by Chiappori (1988) and Chiappori (1992), a divorce threat variant proposed by Manser and Brown (1980) and McElroy and Horney (1981) and a separate

4. The equilibrium types analyzed here follow additional conditions or characteristics not discussed here. Useful discussion are provided by Gravelle and Rees (2004) and Owen (1995).

spheres variant proposed by Lundberg and Pollak (1993). On the other hand, non-cooperative models are based mainly on Ulph's (1988) proposition.

The simplest version of the collective models is the sharing rule approach. The framework is based on the notion of cooperation used in a game theory sense and the idea that under such a decision-making process, interaction will produce Pareto efficient results. The basic assumption of the framework is that households will never adopt decisions that are Pareto dominated (Chiappori, 1997). However, the household behavior instead of being explicitly modeled is assumed under a form of a sharing rule that will produce the expected outcomes. Formally, the model takes the following form, as developed by Chiappori (1988) but introducing some modifications in order to make it suitable for the current research. Consider again a household of of k members, a set of goods (xi), a set of prices (pi) and preferences represented in the following individual specific utility functions

$$\begin{aligned} U_1 &= U_1(x_{1i};\lambda) \\ U_2 &= U_2(x_{2i};\lambda) \\ &\dots \\ U_k &= U_k(x_{ki};\lambda) \end{aligned} \tag{4}$$

In order to allow for interaction among members, the maximization problem under this framework is solved in a two step procedure. In the first step, the overall household income ($M = Yo + \sum_{j=1}^{k} Y_j$) is pooled and distributed between members. The amounts $Y^* = F_j(Y_1, Y_2, \dots Y_k, Y_o, p_1, p_2, \dots, p_q)$ received by each member are known as the sharing rule and depend on incomes and prices. They are set considering the Pareto efficiency property (each member agrees upon the amount permitted to spend). In the second stage, once the sharing rule is identified, each individual solves his own maximization problem of the form

$$\begin{aligned} \text{Max} \quad & U_j = U_j(x_{ji};\lambda) \\ \text{s.t.} \quad & \sum_{i=1}^{q} p_{ji} x_{ji} = Y_j^* \end{aligned} \tag{5}$$

As shown by Bourguignon, et al. (1993), Basu (2004) and Lancaster, et.al. (2003), this maximization problem under the assumption of efficiency can be simplified by

$$\text{Max} \quad W = \sum_{j=1}^{k} \theta_j W_j(U_1, U_2, \dots, U_k) \tag{6}$$

$$\text{s.t.} \qquad M = \theta_j M = \sum_{j=1}^{k} Y_j^* = \sum_{i=1}^{q} p_{1i} x_{1i} + \sum_{i=1}^{q} p_{2i} x_{2i} + \ldots + \sum_{i=1}^{q} p_{ki} x_{ki}$$

$$\sum_{j=1}^{k} \theta_j = 1$$

where the $\theta_j = \theta_j(Y_1, Y_2, \ldots, Y_k, Y_o, p_1, p_2, \ldots, p_q)$ are scalars that lie between 0 and 1 and are set arbitrarily by the household depending on the kind of cooperative agreement reached. A particular point on the Pareto frontier represents specific values for θ_j which corresponds to the weight given to each member in the welfare of the household in this particular situation. Under such conditions and considering k household members, the sharing rule will take the form $Y_j^* = (\theta_j)(M)$. Substituting and solving the maximization problem, the demand functions reached take the form:

$$\sum_{j=1}^{k} x_{ji} = x_i^* = x_i(Y_j^*, p_1, p_2, \ldots, p_q; \lambda) = x_i[(\theta_j) M, p_1, p_2, \ldots, p_q; \lambda] = \ldots \qquad (7)$$

$$\ldots = x_i(Y_1, Y_2, \ldots Y_k, Y_o, p_1, p_2, \ldots, p_q; \lambda)$$

The basic distinction between functions (7) and (3) is the introduction of individual incomes as additional arguments which is just the way in which distributional effects are recognized by the model. Note that they are introduced only through the sharing rule parameter θ_j as an additional determinant which in the framework of standard game theory can be considered as the true measure of the bargaining power of a particular member. This particular characteristic will have interesting implications in the hypothesis testing of the collective framework as discussed in the following sections.

A second version of the collective model is defined as a marriage market or divorce threat approach which, in general, seeks to model the behavioral characteristics of the household bargaining process and the emergence of agreement. In essence, individuals inside the household can reach a binding agreement among different agreement options or they can disagree. In the former case, each member cooperates and allocates the resources in a way that maximizes their collective utility function. In the latter, a threat point is characterized by the payoffs associated with disagreement. In the formal derivation of this collective equilibrium, the payoffs of the disagreement outcome will influence the utility of each individual in the agreement outcome. This process can be summarized mathematically using the notation in Gravelle and Rees (2004).

Consider a k-household member case with different utility functions (preferences), a set of possible agreements P which describes all the possible allocations of consumption (a).

Then the utility of the cooperative game is the set $W = \{U_1(a), U_2(a), ..., U_k(a) / a \in P\}$ and the utility payoffs of the threat point are the set $D = \{U_1^{threat}(\delta_1), U_2^{threat}(\delta_2), ..., U_k^{threat}(\delta_k)\}$. Solving the game we achieve a unique solution (Nash equilibrium) based on three assumptions: W is closed, bounded and convex; $D \in W$ (agree to disagree condition); and $W > D$ (strictly). In this way the bargaining solution can be expressed as the combination set $S = (W,D) = \{S_1(W,D); S_2(W,D); S_k(W,D)\}$ which implies that the bargained solution depends on the determinants of the threat point. McElroy (1997) shows that the demands that maximize the gains of cooperation can be expressed as a solution of the problem:

$$\text{Max} \quad W = [U_1(x_{1i};\lambda) - U_1^{threat}(\delta_1)][U_2(x_{2i};\lambda) - U_2^{threat}(\delta_2)][...][U_k(x_{ki};\lambda) - U_k^{threat}(\delta_k)]$$

$$\text{s.t.} \quad M = \sum_{j=1}^{k} Y_j + Y_o = \sum_{i=1}^{q} p_{1i}x_{2i} + \sum_{i=1}^{q} p_{2i}x_{2i} + ... + + \sum_{i=1}^{q} p_{ki}x_{ki} \tag{8}$$

and the resultant demands can be expressed as

$$\sum_{j=1}^{k} x_{ji} = x_i^* = x_i(\delta_1, \delta_2, ... \delta_k, M, p_1, p_2, ..., p_q; \lambda) = ... \tag{9}$$

$$... = x_j(Y_1, Y_2, ... Y_k, M, p_1, p_2, ..., p_q; z, \lambda)$$

This result has Pareto efficient characteristic among others. The critical elements in this framework are the nature and determinants of the threat point, $U_j^{threat}(\delta_1)$. In the Manser and Brown (1980) and McElroy and Horney (1981) variant of the model, the disagreement outcome which generates it is the family dissolution situation. Hence, δ_j defines characteristics or conditions faced by individuals «alone» and their consumption possibilities in that situation. The literature that provides some rationale to this model is generally grounded on the two-member (husband/wife) household type. For that reason among the elements of δ_j encountered, beyond market prices, are the wage rates prevailing for males and females, any non-wage income available and extra-household environmental conditions (EEP) using McElroy's (1997) definition (like permanent income by gender, productivity, employability, family origin wealth and any institutional conditionings of female and male welfare outside the marriage).[5] All these EEPs which are defined as threat point shifters are associated with the conditions of the marriage and re-marriage market faced by individuals. However, it is not difficult to generalize the elements of δ_j to other members (sons, for example) using the prevailing wage rates and, in the case

5. Is important to note that δ_j captures in some sense the determinants of the bargaining power of the members of the household. As predicted in standard game theory literature, any condition that shifts upwards the wealth level in the threat point of an individual, will result in overall household demands that more strongly reflect the preferences of that individual (McElroy, 1997).

of EEPs, conditions that determine the decision of leave or stay in the household, much of them quite similar to those of the marriage and remarriage market.

In order to render comparable (9) and (7), and understand how to reach to the last expression of (9), note that δ_j describe the determinants of the sharing rule (McElroy, 1997) i.e. it is possible to express $\theta_j = \theta_j(\delta_1, \delta_2, \ldots \delta k)$. Also note from the previous discussion that an intuitive functional form for δ_j will be $\delta_j\ (Y_j\ ;\ z)$ where z represents the EEPs. Then, generalizing for δ_j the expression $\delta_j = \delta_j(Y_1, Y_2, \ldots Y_k, Y_o, p_1, p_2, \ldots\ldots p_q ; z)$ is found and the only difference between expressions (9) and (7) is the introduction of z (EEPs).

Using similar reasoning, Chiappori (1997) recognizes the complementarities of sharing rule models and divorce threat approaches arguing that it is possible to supplement sharing rules by any exogenous variable that may affect the decision process (the introduction of EEPs). However, despite the fact that there is an evident convergence in both approaches, it must be recognized that the main contribution of the divorce threat framework is to give to the determinants of the sharing rule an economic rationale in the context of the marriage market literature or, less discussed, the leaving-stay decision process of sons[6].

In an alternative variant of these types of cooperative equilibria, Lundberg and Pollak (1993) suggest that cooperative solutions need credible threats and day-by-day negotiation. And that divorce or a decision to leave could be a non-credible threat. For that reason, in their separate spheres model, the authors specify a non-cooperative Pareto inefficient solution (with inefficient provision of public goods) as the relevant threat point. This new threat point is specified as a status-quo situation where consumption is assigned inside the household with predetermined roles. The emergence of this new threat point is given by the recognition among members that staying in the household (staying married in

6. A good discussion of the determinants of the equilibrium in marriage markets is provided in Lundberg and Pollak (1993), Lundberg and Pollak (1996) and McElroy (1997). The basic rationale is a model that analyses satisfaction of a husband and wife, the considerations behind who marries whom and why, and the off-household opportunities faced by both. Allowing the possibility of bargaining prior to marriage will influence bargaining inside it and of course the equilibrium reached there. At the same, as long as the same considerations influence remarriage outcomes it is possible to infer its influence on the marriage solution. By contrast, leaving the nest decision of sons is an expected event in the life cycle of the household. One set of literature basically analyzes age and determinants of it. See for example De Vos (1989), Foster (1993), Burch and Mathews (1987), Guinnane (1992) and Johnson and Da Vanzo (1998). A second strand in the literature (closer to game theory insights) analyzes the intergenerational linkages on households. See for example Altonji, et al. (1992), Hoddinott (1994), Silverstein, et al. (1995) and Cox, et al. (1998) for models applied in different contexts. Most of them allow for the possibility of bargaining between members and the conditions of it will also influence equilibriums reached.

the case of couples or not leaving in the case of sons) is better than household dissolution, given the benefits of joint consumption or such other positive externality[7].

Making the threat point internal to the household has important empirical implications. For instance, demand functions, under household dissolution threat points, must be estimated using incomes that each member «will receive» in the off-household case, or by employing the assumption that actual incomes will prevail in those (possibly not too strong in the case of sons or other members, but less accurate in the case of parents, mainly wives) circumstances. By contrast, and rephrasing the arguments of Lundberg and Pollak (1996), a non-cooperative threat point generates demands that, in some circumstances, depend not on who receive incomes after household dissolution but on who actually receives them within the family. Using the previous notation, this implies a change in the elements considered in δ_j including actual incomes received by the members and threat point shifters associated with determinants of non-cooperation inside the household (social and cultural determinants as sexism, altruism or institutional ones related to family formation) or EEPs, as long as they are relevant shifters to this new threat point. Then, under these considerations, expressions (7) and (9) are still relevant theoretical demands for this framework.

The non-cooperative solution is the starting point for Ulph's (1988)[8] proposition, which shows it to be a plausible equilibrium for the demand behavior of the household. The common observation of violence or abusive behavior makes it possible to argue that, in some cases, it is impossible for family members to actually cooperate.[9] Then, neglecting any kind of binding and enforceable agreement, family members develop strategic behavior (i.e. actions are taken individually but conditioned on others' actions). In terms of the utility maximization problem solved in this case, it is better to think on family members as separate agents linked only via some kind of joint consumption. Following Hoddinott and Haddad (1995), the solution of this problem can be expressed in the following way: consider again *k*

7. McElroy (1997) proposes an interpretation of these two different threat points arguing that a non cooperative Pareto inefficient threat can be used by short-run consumption decisions and a household dissolution threat for the long run.
8. The author would like to thank David Ulph from St. Andrew's University for providing his unpublished work.
9. However, a critical point as regards this view is made by Lommerud (1995) who states that efficiency does not imply harmony and that efficient outcomes could also arise under such conditions. However, the main theoretical idea of «difficulties to reach to enforceable agreements in a conflictive interest framework» is maintained and the conditions that generate those difficulties must be explored. Two key points stated in Gravelle and Rees (2004) will be the need to prove the non-sustainability and non-credibility of threats in the context of infinite games. At least from the bibliographical revision carried out for this present research, no attempts to formalize such conditions have been made, and only Ulph (1988) has provided some insights into them. Exploring the theoretical foundations in this context is outside the scope of this paper.

members and goods x_{1i} , x_{2i} , ..., x_{ki} consumed by each member. The representation of preferences is given by the following set of utility functions:

$$U_1 = U_1(x_{1i};\lambda) \qquad (10)$$
$$U_2 = U_2(x_{2i};\lambda)$$
...
$$U_k = U_k(x_{ki};\lambda)$$

similar to those expressed in (4). Under the strategic behavior hypothesis, each member solves the following problem:

$$\text{Max} \quad U_j = U_j(x_{ji}, x_{1i}, x_{2i},..., x_{j-1i}, x_{j+1i},..., x_{ki};\lambda) \qquad (11)$$
$$\text{s.t.} \quad Y_j = \sum_{i=1}^{q} p_{ji} x_{ji}$$

maximizing his own consumption x_{ji} with that of the other members $(x_{1i},x_{2i},..., x_{j-1i}, x_{j+1i},...,x_{ki})$ taken as given. It is demonstrable that each member reaches a reaction function of the form:

$$x_{ji} = R_{ji}(x_{ji}, x_{1i}, x_{2i},..., x_{j-1i}, x_{j+1i},..., x_{ki}, p_i, Y_j;\lambda) \qquad (12)$$

The Nash-equilibrium in this case is the x_{ji} that solves simultaneously the equation system implied in (12) where Pareto optimality is a possibility but not fully guaranteed. At the same time, final demand functions for each good are going to depend on the prices and the particular incomes of each individual:

$$\sum_{j=1}^{k} x_{ji} = x_i^* = x_i(Y_1, Y_2,... Y_k, Y_o, p_1, p_2,..., p_q;\lambda) \qquad (13)$$

One important implication of this model is that control over money in the household does not happen in a «sharing rule» context, rather individual budgeting is a more accurate notion of this process.[10] At the same time, the problem (11)-(13) implies that the notion of

10. It is not stated formally under this framework the influence of household income (Y_o) and how it is used in resource allocation. Some ideas that emerge from the discussion involve appropriation of this kind of income or its use to finance public goods purchases. If the first is the case, then each Y_j is really individual income plus the fraction appropriated from household income (the process of appropriation has not been formally solved but is possible to think on it as a function of the ability of each household member to impose their preferences). If the second is true, then the correct way to solve model is to incorporate an additional reaction function and solve the model subject to the allocations reached. Both interpretations allows us to incorporate in (13) the term Y_o.

collective utility function no longer applies, but the idea of power (i.e. the ability of a member to impose his preferences) is still relevant. As noted by Hoddinott and Haddad (1995), and using the arguments of Sen (1985), this ability is a function of the perceived contribution of the member to the household budget.

An explicit form of the distribution of incomes inside the household is thus needed. Ulph (1988), in the formal derivation of the model, proposes the share of income that belongs to a particular member (also discussed in Hoddinott and Haddad, 1995). Using this definition these authors point out three interesting features of the model. First, if the income is demonstrably skewed toward a specific member then the Nash equilibrium reached will show the preferred allocation of resources of that individual. Second, as the income share of an individual rises, the preferred good by that individual will rise, the preferred good by the other individual will fall and the public goods will fall or rise depending on which individual dislikes more the preferred good of the other. Third, if members strongly disagree on purchasing ordering they can make strategic purchases to pre-commit the household to a minimum level of consumption.

In summary, functional forms of demand expressed in (13), (9) and (7) recognize that distributional effects can actually influence demand patterns and the possible emergence of non-efficient outcomes. This is possible, given the introduction of bargaining processes into the analysis of household expenditure providing several new insights on the nature of the utility maximization problem of the family. The theoretical basis of such models is constructed in contrast to the unsatisfactory answers given by the unitary models to this process and thanks to the analytical tools derived from game theory. The next section tests empirically the adequacy of these theoretical frameworks in the Peruvian context.

2. TESTING POOLING HYPOTHESIS AND PARETO EFFICIENCY

The purpose of this section is to investigate whether the pooling income hypothesis holds and if efficiency is reached. This will give some preliminary insights of household allocation of resources and consumption decisions among Peruvian families. At the same time, it will help develop a suitable path for undertaking further estimations in demand analysis in this particular country, mainly with respect to seeing whether a bargained structure on utility maximization is appropriate and if efficiency in the demand behavior of households can be imposed. However, it must be emphasized that though suggestive, the tests presented here do not distinguish between the different collective models. The strategy followed is purely empirical and a more general theoretical framework needs to be used for that purpose.

2.1 Empirical equations and hypothesis testing

Consider a maximization problem like (6) and demands of the form of (7) for the consumption of one particular good and two household members the male parent ($j = m$) and the female parent ($j = f$). Without specifying the form of the sharing rule, the problem is solved for the Pareto frontier, i.e. for different values of θ_j. Individual demands for each member can be expressed as:

$$x_i^m = x_m(Y_m^*;\lambda) \qquad (14)$$
$$x_i^f = x_f(Y_f^*;\lambda)$$

in the form of Engel curves for consumption neglecting the influence of prices given the standard assumption in cross-sectional work that all households face the same price vectors (see Bourguignon, et.al., 1993 and Deaton, 1997). Since consumption for specific household members is not observed, it is useful to consider the overall aggregate consumption for X_i. Considering that $Y_m^* = F_m(Y_m, Y_f, Y_o)$ and $Y_f^* = F_f(Y_f, Y_m, Y_o)$ represents the full income functions once the total income inside the household has been distributed and following the identity $M = Y_m^* + Y_f^* = \theta M + (1-\theta)M$, the Engel curve for total household consumption must take the form

$$x_i^* = x_i^m[F_m;\lambda] + x_i^f[M - F_m;\lambda] \qquad (15)$$

The fact that the individual incomes enter into (15) only through the sharing rule imposes strong restrictions across goods. With regard to Deaton (1997), one can consider a redistributive policy from an uncontrolled source (Y_o) to a controlled source (Y_m or Y_f) in order to hold constant total income and take the ratios of such change on consumption. The expression reached is:

$$\frac{\partial x_i^*/\partial Y_m - \partial x_i^*/\partial Y_o}{\partial x_i^*/\partial Y_f - \partial x_i^*/\partial Y_o} = \frac{\partial F_m/\partial Y_m - \partial F_m/\partial Y_o}{\partial F_m/\partial Y_f - \partial F_m/\partial Y_o} \qquad (16)$$

It should be noted that the right hand of this expression is independent of i, so the test of Pareto efficiency is simply to verify that the left-hand side is constant across goods. At the same time, under the pooling income assumption a redistributive policy has no effect on consumption. Then the income pooling hypothesis is tested verifying that the numerator and the denominator on the left hand side of (16) are equal to one (or equivalently that $\partial x_i^*/\partial Y_m = \partial x_i^*/\partial Y_f$. In order to test these hypotheses, the framework used is one in which

individual Engel curves and the sharing rule are such that the family consumption function has the following QES form[11].

$$C_i = a_i + b_i Y_m + c_i Y_f + d_i Y_o + e_i \frac{Y_m^2}{2} + f_i \frac{Y_f^2}{2} + g_i \frac{Y_o^2}{2} + \ldots. \quad (17)$$

$$\ldots + h_i Y_m Y_f + i_i Y_m Y_o + j_i Y_f Y_o + \beta_{1i} z + \beta_{2i} \lambda + \varepsilon_i$$

where C_i is total consumption of good i, z are female empowerment measures used as proxies of EEPs, λ are household characteristics and ε_i is a random disturbance. Partial derivatives are easily computed under this specification in order to perform the tests, given the random variation. Hypothesis for income pooling take the form

$$Ho_1 : b_i + e_i Y_m + h_i Y_f + i_i Y_o = c_i + f_i Y_f + h_i Y_m + j_i Y_o \quad (18)$$

for goods i and q (any pair of goods under calculation). However, it is useful to note that Ho_1 can be collapsed to a test of parameters. The test must be carried out in two steps. The first is similar to Phipps and Burton (1998), testing the linear hypothesis $b_i = c_i = d_i$ and $e_i = f_i = g_i = h_i = i_i = j_i$ jointly. If not rejected, then the model will collapse to a QES specified only for total income. The second is to discard a possible rejection due to non-linearities in the Engel curves associated with differences in the influence of different kind of (joint) income. Then, linear hypothesis $b_i = c_i$ and $e_i = f_i = h_i$ must be tested to verify persistent differences in the influence of each individual income. On the other hand, the test of Pareto efficiency is not collapsed to a test of parameters, but since partial derivatives are econometrically identifiable, the test takes the form

$$Ho_{2a} : \frac{(b_i + e_i Y_m + h_i Y_f + i_i Y_o) - (d_i + g_i Y_o + i_i Y_m + j_i Y_f)}{(c_i + f_i Y_f + h_i Y_m + j_i Y_o) - (d_i + g_i Y_o + i_i Y_m + j_i Y_f)} = \ldots \quad (19a)$$

$$\ldots = \frac{(b_q + e_q Y_m + h_q Y_f + i_q Y_o) - (d_q + g_q Y_o + i_q Y_m + j_q Y_f)}{(c_q + f_q Y_f + h_q Y_m + j_q Y_o) - (d_q + g_q Y_o + i_q Y_m + j_q Y_f)}$$

Thomas and Chen's (1994) methodology is followed for testing Ho_{2a}. Since the hypothesis is data dependant, these authors propose cross equation non-linear Wald tests for each combination of goods, using points of the income distribution of the sample data. However,

11. Similar to those used in Bourguignon, et al., (1993); Thomas and Chen (1994); Thomas (1997) and Phipps and Burton (1998). The Engel curves are specified only for the case of one good. The generalization for q means that the demand system must be estimated. Useful discussion around the properties of this particular specification can be found in Allen and Bowley (1935), Howe, et al. (1979), Lewbel (1987) and Banks, et al. (1997).

since numerical values of the Wald test are dependant on the expression used for the hypothesis testing (possibly influencing inference), departures from the main conclusion of the paper are adequately controlled changing the mathematical expression of the null (Agüero, 2007). This means also testing:

Ho_{2b} :

$$[(b_i + e_i Y_m + h_i Y_f + i_i Y_o) - (d_i + g_i Y_o + i_i Y_m + j_i Y_f)]^* .... \quad (19b)$$
$$....^* [(c_q + f_q Y_f + h_q Y_m + j_q Y_o) - (d_q + g_q Y_o + i_q Y_m + j_q Y_f)] = ...$$
$$... = [(b_q + e_q Y_m + h_q Y_f + i_q Y_o) - (d_q + g_q Y_o + i_q Y_m + j_q Y_f)]^* ...$$
$$...^* [(c_i + f_i Y_f + h_i Y_m + j_i Y_o) - (d_i + g_i Y_o + i_i Y_m + j_i Y_f)]$$

Each hypothesis is tested by individual goods (for pooling hypothesis), pairs (for Pareto efficiency) and for the whole demand system. In order to test for robustness, a common approach encountered in the literature is used in contrast to these tests. In most of the applications revised, the redistributive policies are not explicitly modeled as in this application, but rather assumed. This implies replacing equation (17) by:

$$C_i = a_i + b_i M + c_i \frac{M^2}{2} + d_i Y_m + e_i Y_f + f_i \frac{Y_m^2}{2} + g_i \frac{Y_f^2}{2} + h_i Y_m Y_f + \beta_{1i} z + \beta_{2i} \lambda + \varepsilon_i \quad (20)$$

Then pooling income hypothesis is tested verifying that each parameter in (20) is different from zero and testing the linear hypothesis $d_1 = e_i$ and $f_i = g_i = h_i$ just as described. On the other hand testing efficiency is simply verifying that $\frac{\partial x_i^* / \partial Y_m}{\partial x_i^* / \partial Y_f}$ (holding constant M) is constant across goods. This procedure is also undertaken in this application to verify any departures from the main conclusions of the study.

This preliminary analysis will provide the information needed to carry out a detailed demand analysis. For example, it is possible to accept the pooling hypothesis and argue in favor of unitary models or reject it and argue in favor of collective models. At the same time it is possible to verify efficiency in line with a cooperative equilibrium model or reject it providing insights into non-cooperative behavior. However, since non-cooperative equilibria may also be characterized by efficiency, acceptance of Ho_2 may not be a conclusive test. However, it is sufficient to sustain the notion that the cooperative solution is an appropriate way to model household consumption behavior in Peru.

2.2 Database and Econometric issues

a) Database

The data used in the study come from the Peruvian National Household Survey (ENAHO), conducted by the National Institute of Statistics and Informatics (INEI) in the fourth quarter of 2002. The total sample size is 19,673 households with 11,981 cases from urban areas and 7,673 from rural ones. The total data available are restricted in two ways: first, we only consider households where parents are a couple (married or non-married) living together between the ages of 18 and 65;[12] and second, although other members may or may not be present, we only consider those cases where the additional members are not income earners.

These restrictions are imposed so as to fit with the type of household structure used in producing the empirical equations, namely a two-decision family member structure. Most of the empirical testing of collective models relies on cases of two-family member structure: either husband/wife households[13] or parent/son households. Given the data availability, the first structure is adopted here. On the other hand, following Phipps and Burton (1998), excluding additional income earners helps to avoid complications that arise from the fact that those earners must have something to say about how their income is spent. With these restrictions, and after dropping missing values of the main covariates of the analysis, the sample size obtained is 6,844 households.

Income measures were constructed using the official INEI methodology[14], but considering individual earners. Most sources of income are individually reported by household members, so no further assumptions were needed in that regard -- even in rural areas. Overall, income was disaggregated between assignable and non assignable income. Assignable income consists of monetary income (labor income in all dependent and independent activities in principal and secondary jobs and any kind of non-labor transfers). It also includes income in kind (non-monetary dependent earnings and non monetary transfers) and subsistence consumption. Non-assignable income consists of all imputed

12. An age restriction is placed in order to restrict analysis to household formed parents who have attained majority age (18 years old) and to avoid parents of retirement age (65 years or more).
13. For husband/wife structures, see for example, Hoddinott and Haddad (1995), Phipps and Burton (1998), Bourguignon, et al. (1993), Thomas (1997), Quisumbing and de la Briere (2000), Quisumbing and Maluccio (2000) and Lancaster, et al. (2003). For parent/son structures, see for example Hayashi (1995) and Altonji, et al. (1992).
14. All income and expenditure is reported in deflated terms for the mid point of the survey period, in this case mid-November, 2002. The exchange rate in November 2002 for the Peruvian sol was 3.58 soles per dollar (See www.sbs.gob.pe).

consumption at the household level under the category non-paid as well as the imputed values for house rents and other non-assignable transfers received by the household.

Data for consumption were available at the household level and include expenditure realized (effectively paid) and non-realized (consumption without payment). However, consumption of durables is not considered because from the sample used (only one year under investigation) it is difficult to obtain adequate measures of the frequency of such purchases, even given the annual retrospective nature of its design. Three expenditure groups are considered in the study: «all food», «all house» and «all members». Description and basic statistics for all the variables used in the analysis are to be found in the appendix.

b) Econometric Issues

The estimation of the QES Engel curves was made without imposing any restrictions on demand behavior and focused only on those insights derived from testing the pooling and efficiency hypothesis given their primary importance for the rest of the study. Then, specification (17) and (20) were estimated freely for each consumption group supplemented by additional controls of household characteristics (number of members and average age and education years of the parents), a labor supply control (hours worked)[15], proxy variables of female empowerment (difference of age, education and hours worked between the father and mother) and additional controls including a regional dummy for urban zones in order to account for geographical differences. However, in order to reach adequate conclusions at least four econometric problems had to be addressed.

First, a potential selection bias will emerge if a high presence of zero expenditure values across groups is identified. Here the problem is avoided by using highly aggregated groups. As mentioned, the categories used are «all food» (food both in the household and outside it), «all house» including all general household expenditures (domestic goods, transport and communication, and entertainment) and «all members» including expenditures on family members (clothing, education and health). In the first two categories there were no cases of non-zero consumption, while in the third it was less than the 0.1% of cases (which is not considered problematic). The solution also helps to avoid the effects of the standard errors produced by correcting of these for censored systems (see Shonkwiler and Yen 1999). At the same time, another support for using few goods in testing the hypothesis is that the Wald statistics are functions of the number of groups considered. So, as stated by Thomas and

15. The inclusion of this covariate allows us to overcome any non-separation issue between commodity consumption and leisure that might emerge in demand modeling. See Browning and Meghir (1991).

Chen (1994), one can mask rejection of Pareto efficiency just by including several goods, in the joint tests. Then since the main purpose of this exercise is to test this key hypothesis this constitutes an adequate solution.

Second, as expected in cross sectional work, the variance of the errors under specification (17) will not be constant.[16] So, in order to allow for unobservable heterogeneity, all equations are estimated under robust options. Instead of the traditional OLS, the approach used is to compute estimators using variance-covariance matrix correction procedure established in White (1980) and Huber (1967)

Third, the new «grouping» proposed will also help to counterbalance any loss of efficiency produced by the possible emergence of cross equation correlations. As pointed out in Deaton and Muellbauer (1992), it is possible to assume weak separation of preferences (neglect unobservable correlation) under a two-stage budgeting process where groups are formed in such a way that close substitutes and complements are kept in the same group. Moreover, Greene (2003) demonstrates that when the same covariates are used across the system (as in the present application), there is no justification for using SUR techniques since estimators obtained from both procedures are identical (and consistent). However, as mentioned in Wooldridge (2002), there are good reasons for still using seemingly unrelated estimators even under the same specifications (and beyond the gain in efficiency) that arise for the need to test cross-equation restrictions (as in the present application). This cannot be performed in an independent system since the standard errors will not be valid for that purpose.

To overcome the problem, then, OLS estimators are combined in a single parameter vector and the between model (robust) variance covariance matrix is computed. This estimator (developed by Weesie, 1999) shares most of the characteristics belonging to Zellner's (1962, 1963) traditional SUR estimator and it helps us to handle the hetersokedasticity problem of the independent equations (via the estimation of valid standard errors). However, one caveat is that it does not yield the gain in efficiency when the cross equation correlations are explicitly modeled. So, implicitly, the option made in this application for testing the hypothesis of interest is to minimize the potential loss of efficiency under the assumption of weak separation of preferences (given the grouping proposed) and thus solve the heteroskedastic problem. The natural way to handle the problem correctly is to program

16. This was formally tested using the White test for heteroskedasticity.

the SUR estimator in order to include the correct (robust) variance-covariance estimator. This is left for further research.[17]

Fourth, there are at least two covariates that could be endogenous: income and hours worked. There are strong reasons to conclude that income and labor supply are determined simultaneously with consumption leading to an endogeneity problem if these variables are used as exogenous in the empirical application. Under such circumstances, exogeneity must be tested for prior to estimation, and if rejected follow a 2SLS or IV estimator since using OLS techniques will result in biased and inconsistent coefficients affecting the inferences and conclusions reached.

However, as stated in Stock and Watson (2003), in order to test exogeneity, a set of valid instruments must be identified. Multiple attempts were made to find such an appropriate set but most of them proved misleading. Some of the variables explored were those of National Census of 1993, the Economic Census of 1994, the Agricultural Census of 1994, the National Pre-Census of 1999 and the National Survey (ENAHO) of 2001. Also, multiple clustering of data described was carried out at the district and cohort level. None of them passed the relevance (the rule of thumb identified by Stock and Watson, (2003)) or the over identification tests (Sargan, 1983). Thus a further test of exogeneity (Hausman, 1978) was not possible to carry out. Under such circumstances, the un-testable assumption of income and labor supply exogeneity is maintained throughout the paper.

2.3 Empirical results

In Table No. 1 the estimation results for both demand systems are set out: the first including household income and the second incorporating it implicitly via total income. In general, measures of income measures are satisfactorily determined. This conclusion is reached owing to the specific t-statistics for each measure, as well as the F-statistic calculated for each equation. The same conclusion applied to most of the socioeconomic covariates and the regional dummy. The empowerment measures, however, tend to be less significant but, in general, it is possible to identify some of them as being significant at conventional levels. The R-sq for each of the equations is adequate for cross sectional studies. The main point of this exercise is not to interpret the demand equations. However, some preliminary insights can be outlined concerning income and empowerment measures prior to the testing of the hypothesis.

17. In Stata 9 the post-estimation command developed by Weesie (1999) and used in this first model is called SUEST while the traditional Zellner (1962 and 1963) SUR is the SUREG command. The author thanks Professor Mark Schaffer from Heriot-Watt University Edinburgh and Renato Ravina from the University of Minnesota for their valuable remarks on this issue.

Table 1
Demand systems - QES specification

	Demand System (Yo)			Demand System (M)		
	All Food	All House	All members	All Food	All House	All members
M	-o-	-o-	-o-	0.2656715 ***	0.5765003 ***	0.3432798 ***
				(0.0508033)	(0.0995516)	(0.0589098)
M-sq	-o-	-o-	-o-	-0.0000268 ***	0.0000359	0.0000157
				(0.00000645)	(0.0000247)	(0.0000167)
Ypm	0.1422391 ***	0.2418415 ***	0.1008652 ***	-0.1211947 **	-0.3362684 ***	-0.2271533 ***
	(0.0094027)	(0.0314107)	(0.0107212)	(0.0524719)	(0.0996098)	(0.0599352)
Ypm-sq	-0.0000139 ***	-0.0000121	-1.24E-06	0.000014 **	-0.0000448 *	-0.0000138
	(0.00000174)	(0.00000886)	(0.00000291)	(0.00000684)	(0.0000262)	(0.0000169)
Ypf	0.1564536 ***	0.1912776 ***	0.1169628 ***	-0.1170181 **	-0.4116565 ***	-0.2454079 ***
	(0.0293101)	(0.0505402)	(0.0208133)	(0.0592272)	(0.1067046)	(0.0591666)
Ypf-sq	-1.13E-06	2.79E-06	-8.61E-07	0.0000244 ***	-0.0000378	-0.0000191
	(0.00000178)	(0.00000539)	(0.00000167)	(0.00000689)	(0.000026)	(0.0000176)
Ypm*Ypf	-0.0000115 ***	7.94E-06	-9.87E-06 ***	0.0000145 *	-0.0000307	-0.0000275
	(0.00000342)	(0.0000191)	(0.00000274)	(0.00000806)	(0.0000344)	(0.0000173)
Yhh	0.2599674 ***	0.4934943 ***	0.3970936 ***	-o-	-o-	-o-
	(0.040054)	(0.086511)	(0.0390356)			
Yhh-sq	-0.0000124	0.0001602 *	-0.0000297	-o-	-o-	-o-
	(0.0000249)	(0.0000929)	(0.0000261)			
Ypm*Yhh	-0.0000153 **	0.0000559	0.000064 ***	-o-	-o-	-o-
	(0.00000633)	(0.0000389)	(0.0000109)			
Ypf*Yhh	-0.0000522 **	-0.0000577	-0.0000388 *	-o-	-o-	-o-
	(0.0000237)	(0.0000859)	(0.0000236)			
Diff_edu	-1.306621	-0.6710359	-0.5619338	-1.279986	-0.5398206	-0.5403327
	(0.9415645)	(0.94816)	(0.5618919)	(0.9395025)	(0.9444136)	(0.5706671)
Diff_age	-0.3894857	0.4908358	-1.018647 ***	-0.4243241	0.4386108	-1.173989 ***
	(0.5132381)	(0.7679216)	(0.3226563)	0.5130994	0.7696747	0.3439138
Diff_lab	0.0871372	-0.5359686 ***	-0.161349	0.0804569	-0.5676466 ***	-0.1680776 *
	(0.1355927)	(0.2050827)	(0.0991028)	(0.1332408)	(0.1916462)	(0.0983305)
# members	23.65907 ***	-9.938095 ***	10.74201 ***	23.70995 ***	-10.20222 ***	11.33121 ***
	(1.70704)	(1.804283)	(1.170506)	(1.712942)	(1.874043)	(1.255762)
Edu_parents	6.184002 ***	10.57945 ***	9.984813 ***	6.25512 ***	10.51314 ***	10.48597 ***
	(1.282632)	(1.770499)	(0.840313)	(1.285683)	(1.682998)	(0.8810349)
Age_parents	0.3466537	1.662318 ***	1.463631 ***	0.3936735	1.711092 ***	1.6964 ***
	(0.3024811)	(0.4061094)	(0.2206581)	(0.302477)	(0.4025033)	(0.2425076)
Lab_parents	2.055031 ***	-0.1880799	0.1006132	2.061677 ***	-0.1349409	0.084294
	(0.2291012)	(0.3138769)	(0.159271)	(0.2279735)	(0.2980556)	(0.1597285)
Aus_parent	42.17253 **	-11.90093	-18.96743	42.42136 **	-10.30215	-19.1626
	(20.81493)	(23.51312)	(16.61222)	(20.68003)	(23.72278)	(16.19217)
Mig_head	10.7423	26.13602 **	6.613011	10.03116	23.94043 *	4.644361
	(9.516126)	(12.17117)	(7.07547)	(9.487994)	(12.41017)	(7.227936)
# migants	12.01552 ***	-2.381875	-0.7387221	12.06167 ***	-1.936342	-0.9335425
	(4.167388)	(4.453071)	(2.430117)	(4.165794)	(4.381467)	(2.47129)
# room	7.479965 ***	26.94284 ***	5.732209 ***	7.660373 ***	26.14244 ***	7.676413 ***
	(2.766147)	(3.600547)	(2.226779)	(2.815967)	(3.785237)	(2.674301)
Inadeq-house	-5.640634	-14.41758 ***	-3.638712	-5.370842	-14.87699 ***	-1.516275
	(5.80456)	(4.880981)	(3.652848)	(5.839466)	(4.975279)	(3.87999)
Area	44.70309 ***	27.04783 ***	2.850068	44.97948 ***	28.13154 ***	3.370043
	(7.033289)	(8.801973)	(4.745875)	(7.050809)	(8.375002)	(5.192197)
constant	-28.87442	-144.1011 ***	-166.7175 ***	-32.19863	-148.7157 ***	-181.9323 ***
	(20.54459)	(30.66909)	(15.03922)	(20.47407)	(29.7286)	(16.69742)
R-sq	0.3589	0.6825	0.6528	0.3574	0.6782	0.6205
# obs.	6844	6844	6844	6844	6844	6844
Chi-sq (incomes)	453.22	784.61	596.82	408.47	580.05	455.93
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Chi-sq (empow.)	3.73	7.16	12.06	3.69	8.92	14.16
	(0.292)	(0.067)	(0.007)	(0.297)	(0.030)	(0.003)
Chi-sq (joint incomes)		5639.14			1806.59	
		(0.0000)			(0.0000)	
Chi-sq (joint empow.)		20.43			22.94	
		(0.015)			(0.006)	

*** Significant at the 1%

** Significant at the 5%

* Significant at the 10%

Note: Seemingly unrelated estimation. Robust (White/Huber variace-covariance) standard errors in parenthesis; probabilities for tests

First, in the case of the «all food» category, both models reveal a quadratic form for the Engel curve, while it can be noted that the coefficients for female income were higher than for male.[18] These results show the traditional stance of the theory about male and female behaviors within the home. It is expected that mothers tend to care more on the nutritional requirements of the household, mainly if children are present in the home (in some way controlled by the number of members). Anthropological literature tends to connect this behavior to the general idea that females are more bound up in attending to household needs. Even if they develop activities outside the home (working for example), they spend more time in the home or «worry» more about their household activities. Other socio-economical characteristics have the expected signs as well as the regional dummy.

Second, in the case of «all house», the systems tend to reveal themselves in linear form. However, in this case, coefficients tend to be slightly higher for the income of the father. Several components of this group, like entertainment and transport and communication, support this finding. For example, some applications find entertainment as adult-male consumption (see Hoddinott and Haddad, 1995) or in the case of transport and communication one can infer that given a higher propensity of males to devote time to off-household activities, their consumption of this sort of goods is greater.

It is interesting to note that the empowerment measure statistically significant for this group (difference in hours worked) is negative. This is difficult to interpret. From what we know about relative bargaining power, a negative coefficient possibly shows the influence of empowerment on female-related consumption in this group. However, from the information provided by the income measures, this maybe is not the case, and it may rather reflect the influence of the time spent by women away from the home. If this variable is proxying time spent by the woman in off-house activities, it would be reasonable to see this as having a negative influence on consumption devoted mainly to on-household goods. Notice that the main category in this group is household goods. Holding everything constant, it is possible that mothers that spend more time away from the household are less likely to undertake domestic activities.

Third, in the case of «all members» group both systems tend to reveal a linear relationship between income and consumption. An interesting point that emerges here is that income measures tend to be higher for the mother in the first model while higher for the father in

18. These results are similar to Phipps and Burton (1998), Hoddinott and Haddad (1995), Thomas and Chen (1994), Thomas (1997), and in general to the findings of Quisumbing and de la Briere (2000) and Quisumbing and Maluccio (2000). However, they differ from those reached by Bourguignon, et al. (1993) and Lancaster, et al. (2003).

the second. In the first case, the result can be interpreted «again» in terms of a higher propensity of the mother to «invest» in her family members, given the anthropological roles described above. All the items included in this category -- such as clothes, care goods, education and health -- can be explained in these terms. At the same time, this result is confirmed by the estimated effects for the empowerment proxy of differences in age or hours worked which are well determined in this case.

However, in contrast with the «all food» category, this is not a finding that is consistent across the literature. For example, in the case of human capital investment, fully consistent results with the anthropological literature are to be found in Thomas and Chen (1994) for Taiwan and Thomas (1997) for Brazil identifying a greater impact of female income on education and health. In contrast, Quisumbing and de la Briere (2000) for rural Bangladesh only find conclusive evidence of a positive relation between female assets and education consumption but not for heath consumption (where a negative impact is encountered under most specifications of the model). Similar findings are obtained by Quisumbing and Maluccio (2000), where a positive association between health expenditures and a wife's assets is found only in one of their applications for different African countries. Lancaster, et al. (2003), found non-linearities on the impact of the bargaining power on health and education expenditures also in the African context.

In the case of clothing and care expenditures the doubts are even greater. For example, Hoddinott and Haddad (1995), Lancaster, et al. (2003), Thomas and Chen (1994) and Phipps and Burton (1998) found a negative association between clothing expenditure and female incomes even in cases where child clothes are disaggregated for the overall group. This result is explained by Hoddinott and Haddad (1995) for Cote d'Ivoire where educational expenditures are mainly a male responsibility and child clothes could be interpreted as a complementary good. In contrast, Quisumbing and Maluccio (2000) found a positive association between clothing and wives' assets for rural Bangladesh, but no well-defined results in the case of African countries. The same result is to be found in Bourguignon, et al. (1993) for France where most of the estimated coefficients in this particular category are not statistically significant.

In general, most of the differences are related to the specificity of the country modeled and the specification of the demand equations. This probably is the source of the lack of robustness on the sign when changing the specification of the demand. It seems perfectly possible to argue that both parents may be prone to invest in their household members (in the case of human capital, for example).

Table 2
Test for income pooling hypothesis (different specifications)

Model	Test	Demand System (Yo)			Demand System (M)		
		Chi-Sq	Prob.	Inference	Chi-Sq	Prob.	Inference
«All food»	Non significance of individual incomes	-o-	-o-	-o-	73.27	0.000	R
	Equality of effects (income types)	133.94	0.000	R	-o-	-o-	-o-
	Equality of effects (incomes by gender)	42.27	0.000	R	62.53	0.000	R
«All house»	Non significance of individual incomes	-o-	-o-	-o-	76.41	0.000	R
	Equality of effects (income types)	145.63	0.000	R	-o-	-o-	-o-
	Equality of effects (incomes by gender)	2.37	0.498	NR	3.01	0.390	NR
«All members»	Non significance of individual incomes	-o-	-o-	-o-	33.35	0.000	R
	Equality of effects (income types)	193.47	0.000	R	-o-	-o-	-o-
	Equality of effects (incomes by gender)	10.56	0.014	R	9.32	0.033	R
Whole system	Non significance of individual incomes	-o-	-o-	-o-	615.08	0.000	R
	Equality of effects (income types)	1832.1	0.000	R	-o-	-o-	-o-
	Equality of effects (incomes by gender)	53.20	0.000	R	171.47	0.000	R

Note: NR (Non-Rejected), R (Rejected)

Once the demand structures have been estimated, hypothesis testing can begin. In Table No. 2 the results for Ho_1 are presented (the null hypothesis of income pooling). The joint test for the whole system under both specifications reveals a rejection of the null, so it seems plausible to argue that Peruvian households do not behave as a unit and are better conceived of as aggregations of people that bargain over consumption decisions. These findings add further evidence to the empirical regularity found across developing and developed countries and support once again the theoretical idea of collective models over unitary ones (see Alderman, et al., 1995 and Haddad, et al., 1997).

As regards specific goods, the findings against non-pooling are conclusive for the «all food» and «all member» groups. The evidence suggests that for both types of goods preferences among household members differ and the allocation of resources related to them is achieved through bargaining. By contrast, the results suggest non rejection of the pooling hypothesis for «all house» goods. This evidence is consistent with the findings of Phipps and Burton (1998) and Thomas (1997). In their disaggregated study for Canada in the first case and for Brazil in the second, they find evidence in favor of the pooling income hypothesis for similar categories of goods as considered here (housing expenditures, house operations, recreation and household goods, among others). The supportive evidence provided by Phipps and Burton (1998) relates to the anecdotal evidence that these goods tend to be associated with fixed schedule payments (basically house rent) in the Canadian context, and that under those conditions pooling resources may be more efficient for household members. This seems plausible in the Peruvian case as well. Thomas (1997), on the other

hand, links this to the notion of household «public goods» where the emergence of pooling resources is a natural result.

Despite this specific result, and considering that is totally natural to find some consumption groups in which expenditure decisions are reached through pooling income rather than bargaining, the evidence for the whole system (evaluating jointly the tests for each consumption) provides the support necessary for choosing which of the collective models if demand systems are going to be estimated. It is also consistent with the significance found for the empowerment variables shown in Table 1. Following the discussion about the EEPs and threat point shifters in Mc Elroy (1997) and Lundberg and Pollak (1993), their significance underlines the importance of the ultimate determinants of the relative bargaining powers in household resource allocation. Through this framework then it is possible to identify the evidence of negotiation inside the family, at least in the two-member household approach considered here.

With this evidence, it becomes possible to verify whether the efficiency hypothesis for Peruvian households (Ho_2) holds. In Table No. 3 the results of the different specifications in the different specifications in the tests are presented. As shown, Wald statistics are in general very low and the null is not rejected in most cases at conventional levels (only the combination «all house»-«all members» for 25 percentile is rejected at the 10%). Thus it is possible to conclude that Peruvian households bargain and this bargaining process produces efficiency in the allocation of resources. This evidence adds weight to the cooperative model for intra-household allocation of resources. It is important to mention that the non-rejection of efficiency is also an empirical regularity in the different applications. For example, Bourguignon, et al. (1993), Thomas and Chen (1994), Chiappori, et al. (2002), Thomas, et al. (2002), Quisumbing and Maluccio (2003) and Rangel and Thomas (2005) cannot reject the null of efficiency for developing and developed countries.

However, as mentioned above, one of the criticisms made by Agüero (2007) towards these studies is the well-known sensitivity to the different formulations of the non-linear Wald test. So an adequate control for possible deviations is made changing the specification for the null. The bottom panel on Table 3 corresponds to the second specification of the hypothesis. The warning is not fully relevant in this application since there is not a generalized increase in the point estimates of the Wald statistic or in the incidence of rejection at conventional levels of inference. The main conclusion can thus be considered to hold and to be robust for different specifications.

Table 3
Test for efficiency in bargaining (different specifications)

		First specification (Ho2a)											
		Mean			P - 25			P - 50			P - 75		
		Chi-sq	Prob.	Inference	Chi-sq	Prob.	Inference	Chi-sq	Prob.	Inference	Chi-sq	Prob.	Inference
Demand System (Yo)	All food - All house	0.84	0.358	NR	0.91	0.341	NR	0.88	0.349	NR	0.83	0.361	NR
	All food - All members	0.19	0.660	NR	0.09	0.761	NR	0.13	0.718	NR	0.21	0.646	NR
	All house - All members	2.44	0.118	NR	3.09	0.079	R	2.69	0.101	NR	2.25	0.133	NR
	Joint test	3.09	0.214	NR	3.52	0.172	NR	3.23	0.199	NR	2.93	0.231	NR
Demand System (M)	All food - All house	0.69	0.406	NR	0.79	0.374	NR	0.72	0.395	NR	0.67	0.414	NR
	All food - All members	0.36	0.551	NR	0.25	0.620	NR	0.30	0.587	NR	0.38	0.540	NR
	All house - All members	0.37	0.540	NR	0.77	0.379	NR	0.51	0.474	NR	0.28	0.594	NR
	Joint test	0.99	0.611	NR	1.36	0.508	NR	1.10	0.576	NR	0.89	0.641	NR
		Second specification (Ho2b)											
		Mean			P - 25			P - 50			P - 75		
		Chi-sq	Prob.	5%	Chi-sq	Prob.	5%	Chi-sq	Prob.	5%	Chi-sq	Prob.	5%
Demand System (Yo)	All food - All house	1.46	0.227	NR	1.36	0.243	NR	1.36	0.243	NR	1.44	0.231	NR
	All food - All members	0.27	0.603	NR	0.12	0.734	NR	0.17	0.682	NR	0.30	0.586	NR
	All house - All members	1.79	0.181	NR	1.90	0.168	NR	1.83	0.176	NR	1.71	0.190	NR
	Joint test	2.62	0.454	NR	2.37	0.499	NR	2.44	0.486	NR	2.60	0.458	NR
Demand System (M)	All food - All house	1.00	0.316	NR	1.07	0.302	NR	1.00	0.319	NR	0.97	0.324	NR
	All food - All members	0.49	0.484	NR	0.31	0.578	NR	0.38	0.537	NR	0.52	0.470	NR
	All house - All members	0.35	0.556	NR	0.71	0.400	NR	0.48	0.490	NR	0.27	0.607	NR
	Joint test	1.22	0.748	NR	1.51	0.680	NR	1.29	0.731	NR	1.14	0.768	NR

Note: NR (Non-Rejected), R (Rejected).

By specific pairs of goods, it is important to note that the higher Wald statistics come from «all house» group when combined with the other two categories. Given that these do not imply a rejection of the efficiency hypothesis at conventional levels of significance (except in one case), there is not need to explore this result much further. However, an important point arises here since «all house» group is possibly characterized by a pooling income behavior (a different kind of efficiency is reached in this case, i.e. without an explicit bargain). If that is the case, the relevant groups to compare with are those where the pooling hypothesis is rejected, In the case of for «all food» and «all members» categories there is not a single case where the hypothesis of efficiency is rejected and the Wald tests are in general the lowest of all the tests performed.

Finally, if our analysis is a mainly concerned with identifying general behavior within the family, it is better to focus on the joint tests where again at a conventional level the non-rejection of the null is guaranteed. From all this evidence we can make a first general conclusion: that members of Peruvian households have different preferences and tend to bargain over their consumption decisions. Such bargaining leads to Pareto efficient outcomes in resource allocation. A cooperative model therefore appears to be the most suitable way to model demand systems for Peru.

CONCLUSIONS

Intra-household bargaining models provide new insights about consumption allocation and demand behavior within the family. With the tools provided by a game theory framework, they allow modeling of the interaction among household members and show how different preferences are reconciled. In contrast with unitary models, where the household is assumed to act as one and the pooling income hypothesis emerges naturally in utility maximization, the Marshallian demands implied by this alternative approach show that individual incomes have an independent effect on consumption patterns. The implications of this are important. First, equilibrium conditions will depend on the particular kind of interaction assumed (cooperative and non-cooperative). The Pareto efficient condition on demand patterns thus is not fully guaranteed and becomes an empirical question. Second, it is not only increases in income that have an effect on the level and shape of the consumption bundle. Under collective models, redistribution of the income inside the family, holding total income constant, has an additional effect. Moreover, this last observation implies, that demand elasticities tend to differ among members and overall household elasticity is no longer a valid concept.

These considerations have been explored across the paper via a detailed discussion of the theoretical grounding of the different household models. The focus has been on the unitary model, the cooperative model in three of its variants (sharing rule, divorce threat and separate spheres) and the non-cooperative models. As shown, their different predictions about the pooling income hypothesis and the efficient condition of consumption decisions allow them to be tested empirically to identify which is the most suitable way to model demand in the Peruvian context.

The tests performed show that members of Peruvian households have different preferences and tend to bargain over their consumption decisions. This bargaining leads to Pareto efficient outcomes in resource allocation. A cooperative model emerges as the most suitable way to model demand systems in Peru. This result was robust to different specifications of the demand equations and the statistical tests performed. The results suggest that most of the bargaining process is carried out via incomes, but as shown, the significance of the empowerment measures remain in most of the models solved; so if those covariates are interpreted as threat point shifters, this evidence alone casts doubt over the non-bargaining framework.

This paper adds new evidence to the international literature about validating collective models in developing countries. Furthermore, this is the first time that this kind of framework is used to estimate demand patterns for Peru. However, beyond the implications

of the results presented, further research is needed to address several points. The first issue is related to the «non-tested» assumption about labor supply and income exogeneity. If this is not the case, then the estimated coefficients can be biased and many of the conclusions may need to be modified. If this problem is to be overcome, more work is needed to find the adequate instruments to test the hypotheses and evaluate possible departures.

The second issue is related to improvements in estimating standard errors. As discussed (and under the assumption of income exogeneity), the coefficients presented in the study are consistent. However, some loss of efficiency remains. The problems encountered were: unobserved heteroskedasticity on the independent demand equations and cross-correlation of errors between equations, These problems were corrected using the tools provided by the statistical package used (Stata 9), prioritizing those considered more problematic in the application. To handle all the problems and obtain some efficiency work must be undertaken in programming SUR estimations under heteroskedasticity assumptions or robust Murphy-Topel variance-covariance matrices.

Finally, it should be noted that since bargaining models have been validated, the scope for public policy interventions in Peru has increased. For instance, certain consumption bundles are assumed to have a better impact than others in the wealth of family members. For example, consumption of education by the children, health and nutrition certainly influences wealth more than liquor or cigarettes. Therefore, if there is a relationship between a certain kind of consumption bundle and the control over resources of a particular family member, it is possible to derive policy recommendations that are oriented towards promoting policies that target income through increasing the income controlled by a specific member, encouraging a redistribution of it within the household and enhancing their empowerment within the family. For instance, the anthropological insights provided by Rosaldo (1974) and Ortner (1974) about the role of women in the family (the mother who is closer to domestic activities and household needs) enables us to infer ex-ante a more pro-welfare consumption by them.

The main purpose of this application was not to find these correlations, but some evidence seems to be conclusive for the close relation of food consumption and wife's income. However, this evidence is still weak in case of other pro-welfare consumption groups: health and education, for example. Then, a natural extension to this paper is to estimate a more disaggregated demand system imposing the restrictions encountered here, in other words the use of a cooperative model. Use of the appropriate demand specification and more theoretically grounded approach (different from the fully practical specification used here), specific-member demand elasticities can be established. This is left for further research.

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APPENDIX

1. Endogenous

	Description	Mean	Std. Dev.
All Food	Consumption groups including food on-household and food off-household	427.63	304.45
All House	Consumption groups including household goods, T & C and entertainment	318.12	520.94
All members	Consumption groups including clothing and care, education and health	193.00	288.70

2. Exogenous

	Description	Mean	Std. Dev.
M	Total household income (Ypm+Ypf+Yhh)	1036.62	1456.78
Ypm	Income of the father	678.68	1049.65
Ypf	Income of the mother	201.44	679.86
Yhh	Household income	156.50	224.89
# members	Number of members of the household	4.56	1.61
Edu_parents	Average of the years of eductation reached by the father and mother	8.60	4.36
Age_parents	Average age of the father and the mother	37.26	9.78
Lab_parents	Average hours worked per week by the father and the mother	38.09	16.28
Aus_parent	Dychotomical; 1: if one of the parents is absent from the household (different reasons) / 0: if present	0.02	-o-
Mig_head	Dychotomical; 1: if the head of the household is a migrant / 0: if not migrant	0.37	-o-
# migants	Number of migrants in the household (including the parents)	1.04	1.33
Diff_edu	Difference in the years of the education of the father and the mother (years of the father minus the years of the mother)	1.59	3.53
Diff_age	Difference in age of the father and the mother (age of the father minus age of the mother)	3.71	5.60
Diff_lab	Difference in hours worked of the father and the mother (hours of the father minus hours of the mother)	23.40	30.45
# room	Number of rooms of the household (not including bathrooms, kitchen, garage)	2.59	1.46
Inadeq-house	Dychotomical; 1: if household is house present physically inadequate characteristics (INEI definition of NBI-1) / 0: otherwise	0.16	-o-
Area	Dychotomical; 1: Urban zones / 0: Rural zones	0.51	-o-

Sources: National Survey IV Quarter 2002 (Enaho/INEI), National Economic Census 1994 (INEI), National Pre-census 1999, National Poverty Map 2000 (MEF/Foncodes) and National Agropecuarian Census 1994 (INEI/Minag). Information of the Data bases can be found in www.inei.gob.pe; www.mef.gob.pe; www.foncodes.gob.pe and www.minag.gob.pe