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Three Essays On Applications Of Intrahousehold Resource Allocation Models

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THREE ESSAYS ON APPLICATIONS OF INTRAHOUSEHOLD RESOURCE ALLOCATION MODELS

by

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ABSTRACT

This dissertation consists of three chapters on the topic of intrahousehold resource allocation models. The first chapter tests the unitary and general collective models of intrahousehold resource allocation for various household compositions. I find that, for the quasi-quadratic Engel curve specification, the overall results support the previous findings in the literature that the unitary model fails to explain how resources are allocated for all household types. However, when using the QUAIDS specification, the results can reject the unitary model only for smaller-sized households. The general collective model, on the other hand, cannot be rejected in either quasi-quadratic or QUAIDS and not in any of the household compositions. Overall, the results support the general collective model of household behavior rather than the unitary model.

The second chapter derives and tests restrictions imposed by the collective model for households with more than two decision-makers in the absence of price variation. It extends the two-decision-maker model in chapter one to derive the testable restrictions for households with multiple decision makers using unconditional demand systems. Moreover, for comparison, a particular type of demand system that is conditional on distribution factors is also estimated as an alternative way to test the collective model. The results show that neither unconditional nor conditional demand systems can reject Pareto efficiency. Therefore, both approaches provide consistent outcomes supporting the hypothesis that the multiple-decision-maker households in Thailand behave in the Pareto efficient manner predicted by the collective model.

Finally, my third chapter attempts to examine how one can exploit household-level consumption data to recover information about individual household members for situations with no price variation. By combining consumption data from single and couple households, I am able to estimate the resource shares and indifference scales (a variation of the standard equivalence scales in the collective settings) for each household member via a system of Engel curves. The results show that, in Thailand, wives are likely to have higher resource shares than husbands in the married-couple households, while wives with higher education have the ability to extract more household resources. However, resource shares for wives are smaller for older-married compared to younger-married couples. Moreover, if a female were to live alone, she would need approximately three-quarters of the couple's income to reach the same indifference curve, and hence the same standard of living, that she would attain as a wife in the married-couple household.

I dedicate this dissertation to my family, especially my parents and my wife, Jane. Without their understanding and support, the achievement of this work would not have been possible.

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INTRODUCTION

Conventional economic analysis of consumption and welfare treats members of households as if they behaved as a single individual. This unitary perspective has been challenged by the collective approach, which emphasizes how the consumption and welfare of individuals partly depends on economic and social interactions within households. The unitary and collective models have different implications for the welfare effects of public policy and for the assessment of inequality in society, and for this reason many researchers have tested these models. A body of evidence has accumulated that rejects key implications of the unitary model, and a smaller body of evidence exists supporting predictions of the collective model.

Previous tests of the unitary and collective models, however, suffer from at least four shortcomings. First, in most prior work, models are tested only for one particular type of household composition, usually a married couple with no children. But household composition, as measured by the number, ages, and genders of household members, is known to influence consumption decisions. The presence of children has a particularly strong influence on household behavior. It is not clear whether test results obtained for one type of household apply more broadly to other types. Second, prior tests of unitary and collective models without price variation have relied almost exclusively on one functional form for describing household consumption behavior, the quasi-quadratic Engel curve. This functional form is not consistent with preference maximization and is not typically employed in analysis of household expenditures using the unitary model. It is not clear whether rejection of the unitary model in this setting, or support for the collective model, is an artifact of the peculiar choice of functional form. Third, the testable implications of the collective model have not been derived for all applications. Specifically, testable restrictions for households with more than two decision-makers have not been derived for situations with no price variation. Many households may include more than two persons with a voice in decisions, and cross-sectional analyses of consumption almost always must be conducted in the absence of price variation. Fourth, prior studies have given relatively little attention to whether a statistically significant difference between unitary and collective models translates into a substantive difference in conclusions about economic welfare.

This dissertation addresses these four issues using cross-sectional consumption data from Thailand. The dissertation is organized as follows. The first chapter tests the unitary and general collective models of intrahousehold resource allocation for various household compositions, using both the quasi-quadratic functional form and the utility-theoretic Quadratic Almost Ideal Demand System (QUAIDS) commonly employed in the analysis of household budgets in the unitary framework. The second chapter derives and tests restrictions imposed by the collective model for households with more than two decision-makers in the absence of price variation. It extends the two-decision-maker model in chapter one to derive the testable restrictions for households with multiple decision makers using unconditional demand systems. Finally, since measuring consumption inequality is a major application of the analysis of household expenditures, the third chapter attempts to estimate measures of consumption inequality that are based on the collective model.

CHAPTER ONE: TESTING THE UNITARY VS. COLLECTIVE MODELS OF HOUSEHOLD BEHAVIOR USING THAI CONSUMPTION DATA

1.1. Introduction

Economic policy analyses often focus on individual welfare based on such outcomes as level of income, consumption, literacy, employment, or health condition. However, it is widely recognized that the welfare of an individual is based not only on own decisions, but also on the economic and social interactions within the household. These interactions can be affected by the process of allocating resources among household members, and the outcomes of this process can be referred to as intrahousehold resource allocation. Several models of intrahousehold resource allocation exist in the literature to examine household behavior: unitary model (Samuelson 1956; Becker 1981), general collective model (Chiappori 1988, 1992), cooperative bargaining model with cooperative outcome (Manser and Brown 1980; McElroy and Horney 1981), and cooperative bargaining model with noncooperative outcome (Lundberg and Pollak 1993).

If we assume that households make consumption decisions as if they maximize a single utility function given a budget constraint, then we must predict that only total household income should matter in their consumption decisions and the various sources of income should be irrelevant. However, the unitary model has been challenged by a number of empirical studies that have rejected this income pooling hypothesis using different data sets from different countries (Schultz 1990; Thomas 1990; Bourguignon et al. 1993; Thomas and Chen 1994; Lundberg et al. 1997; Ward-Batts 2008). Thus, collective models of household behavior which do not predict income pooling have attracted increasing attention from economists during recent years. This chapter will attempt to test these two models of intrahousehold resource allocations using consumption expenditure data from Thailand: the unitary model which assumes that each household maximizes a single utility function subject to its pooled budget constraint; and the general collective model which assumes that each household member has separate utility functions, and that the household reaches a Pareto efficient outcome.

However, neither the unitary nor the collective models have taken into consideration the possibilities that different household types may have different allocation methods. By different household types, I refer to households with a different number of people living in the same house. Different regions and countries are likely to have different household compositions. According to Bongaarts (2001), average household size in the developing world during 1990 to 1998 ranges from 4.8 in Latin America to 5.6 in the Near East/North Africa; with 5.1 in Asia and 5.2 in Sub-Saharan Africa. On the other hand, the average household size in the developed countries during late 1990s is much lower ranging from 2.1 in Sweden to 3.1 in Ireland; with 2.6 in United States and Canada, 2.5 in France, and 2.4 in United Kingdom (Economic Commission for Europe Statistical Division, 2001).

Moreover, households consisting of spouses only are likely to behave differently from households consisting of spouses with children on how to allocate resources among household members. As noted by Browning (1992), every aspect of household economic behavior is significantly correlated with the presence of children in the household. For example, young children are correlated with lower labor supply by the mothers while older children are correlated with higher consumption by the household as a whole. Even when comparing among nuclear families, smaller-size and bigger-size families may behave differently when some decisions need to be made within the family.

Apart from children, it is fairly common in many developing countries to have other types of dependents living in the same house. This may partly contribute to the fact that most developing countries have larger average household size than that of developed countries. This is also common in Thai society where the average household size is 4.4 in year 1990 and 4.0 in year 2000 (National Statistical Office Thailand, 2000). These dependents may include household head's and spouse's grandchildren, parents, grandparents, cousins and other blood relatives who have no income. Consequently, their consumption allocations depend only on incomes of household head, spouse, or other income earners of the family. All of these differences in household types imply that, in some cases, when we reject the income pooling hypothesis on one particular household type in one particular region, it does not necessarily mean that we will have to reject the same hypothesis when considering other household types in other regions. This is also true in the case of other alternative models.

There are two concerns that should be mentioned when we try to analyze the models of intrahousehold resource allocations. First, it is difficult to determine how resources are actually allocated within households since in most household surveys, consumption and expenditure data are collected at the household rather than individual level so individual consumption is not directly observed. Without individual level data, it is difficult to determine which individuals are consumers of goods purchased by the household. For example, housing expenditures have a public good component within the household. Expenditures on specific goods may be assignable such as expenditures on men's, women's, and children's clothing. Even for such assignable goods, however, there may be externalities within the household; for example, an individual within the household may care whether other household members are well dressed. Another example is that, in most parts of the world, women are more responsible for purchasing food than men. This information, however, does not tell us how the food will be distributed among household members (Doss 1996).

Second, endogeneity of the distribution of income within the household may create problems when testing these models. An example is earned income since its distribution and magnitude depend on hours worked by each member, which may be determined jointly with household expenditures. As noted by Browning and Meghir (1991), if hours of work affect preferences between individual goods then demand systems that take no account of this dependence may give biased estimates. However, testing these models based on unearned income instead of earned income may mitigate but does not completely avoid this problem. For example, as pointed out by Lundberg et al. (1997) and Ward-Batts (2008), income from assets may be correlated with past and current labor supplies, while public and private transfers may be responsive to household distress due to unemployment or bad health, and may be related to expenditures through the events that prompted them. Other sources of unexpected unearned income that are not subject to these concerns tend to be irregular, so they are not appropriate sources of income to test these models.

In order to test these two models in a consistent framework, I follow the strategies adopted by Bourguignon et al. (1993) and Thomas and Chen (1994) who apply a theoretical model of collective decision making which nests both the income pooling and the Pareto efficient hypotheses within a general specification of consumption behavior. In this framework, the assumption of Pareto efficient allocation within the household generates testable restrictions on the parameters of the model. This may be done by observing only aggregate household consumption of goods rather than individual consumption levels, so we need not to assume that goods are assignable. Moreover, instead of treating household income as endogenous, I will treat household income exogenously by using the data of couples in which both partners are full-time employees in the paid labor market as suggested by Bourguignon et al. (1993). Using exogenous income in testing these two models may reduce the endogeneity problem of income distribution by making household consumption decisions independent from household leisure choices.

This chapter is organized as follows: Section 1.2 gives a brief review of the existing theoretical literature on models of household behavior. Section 1.3 provides details of the unitary and the general collective models together with their testable restrictions. Section 1.4 describes sample data. Section 1.5 outlines the empirical model of household expenditures estimated in this chapter and presents results. Finally, the conclusions are provided in Section 1.6.

1.2. Models of household resource allocations

The early models of household behavior, not unexpectedly, were extensions of existing models of individual behavior and hence are termed unitary models. For example, Samuelson (1956) proposes modeling household as if they are maximizing a single household utility function reached by consensus among individual household members so that the household can be considered as an elementary decision unit. An alternative justification for this traditional model is that there is one household member (a dictator) who determines all allocations from the point of view of an altruist who cares about other household members (Becker 1981). The unitary approach has the advantages of simplicity and convenience because the results derived for individual can be directly extended to the household situation.

One implication of the unitary model is that only total household income, and not the separate incomes of individual members, will affect household demands. Which household member receives income is irrelevant to the allocation of household resources. Rejection of the pooling hypothesis, and hence unitary model, has important implications for the effectiveness of policies aimed at improving welfare of particular household members. The unitary model implies that transfer policies that attempt to redistribute income to particular household members will be neutralized by reallocations of household resources. The welfare of the targeted member may be improved, but no more or less than if the transfer had been given to another household member. In other words, a dollar of the transfer income has the same effect on household demands whether the transfer is made to the husband or to the wife.

While treating the household as a single homogeneous unit has the advantages of simplicity and convenience, aggregating a group of individuals into a household in this way involves invoking assumptions that are not theoretically attractive. i.e., all household resources are pooled. The unitary model also has been challenged by a number of empirical studies that have rejected the income pooling hypothesis (Schultz 1990; Thomas 1990; Bourguignon et al. 1993; Thomas and Chen 1994; Lundberg et al. 1997; Ward-Batts 2008). On the other hand, a variety of collective models of household behavior have been developed to allow for the possibility that each household member has distinct preferences. These models do not impose the income pooling hypothesis. They include general collective model (Chiappori 1988, 1992), cooperative bargaining model with cooperative outcome (Manser and Brown 1980; McElroy and Horney 1981), and cooperative bargaining model with noncooperative outcome (Lundberg and Pollak 1993).

The general collective model proposed by Chiappori (1988; 1992) allows the husband and wife to have separate utility functions. This model assumes only that husband and wife somehow choose an allocation of resources which is Pareto efficient such that neither could be made better off by a redistribution of consumption goods without making the other worse off. This model does not specify the process used by the household to reach Pareto efficiency, so it is not a bargaining model. This is equivalent to the assumption that couples first share non-labor income; then, given individual shares, each spouse chooses labor supply and consumption to maximize his or her well-being. Sources of income can matter from this perspective if contributions to total income influence the share one is allocated. This framework was designed to let the data describe intrahousehold resource allocations and to use a minimum number of assumptions to gain as much information from the data as possible.

The cooperative bargaining model of household behavior was initially developed by Manser and Brown (1980) and McElroy and Horney (1981). They propose a bargaining framework in which household decisions are made through a cooperative Nash-bargaining game. In McElroy and Horney's model, it is again assumed that husband and wife have separate utility functions, and each spouse receives utility from a pure public good. In addition, each spouse values leisure and consumption of private goods. They solve a Nash-bargaining problem in which each individual's threat point depends on options outside of the marriage; it is the utility that each spouse would obtain if divorced. In addition to Pareto efficiency, the Nash bargaining solution assumes three more axioms: symmetry, independence of utility origins and units, and contraction independence (see Vermeulen 2002). To the extent that current income is a predictor of income options in the event of divorce, each spouse's individual income will affect relative bargaining power and hence the allocation of resources. In addition to income, the cooperative bargaining model suggests that factors such as divorce laws, child support laws, tax laws and transfer programs will affect relative bargaining power. McElroy (1990) refers to such factors as "extrahousehold environmental parameters." Browning et al. (1994) refer to them as "distribution factors."

Since it may be too extreme to suppose that spouses threaten divorce over every marital disagreement, alternative threat points should be considered. Lundberg and Pollak (1993) propose what they call "the separate spheres bargaining model" in which threat points are noncooperative outcomes within the marriage which reflect traditional gender roles. If an agreement cannot be reached through negotiation, gender roles determine each individual's contribution to household public goods within their respective spheres of influence; for example, men may be responsible for expenditures on housing, while women are responsible for expenditures on child care. The implication of this model is that it generates corner solutions in the provision of public goods. Because public goods are provided voluntarily, they may be underprovided within the household, as is typical in models with voluntarily provided public goods. So, both Pareto efficient and non-Pareto efficient outcomes are consistent with this model.

1.3. Testing unitary versus collective models

Each model described in previous section has a different set of assumptions and makes different predictions about how resources will be allocated within households. To examine a model, it is important to test the validity of the predictions against the data to see whether outcomes are consistent with the model. In this chapter, I will focus on testing the unitary model and the general collective model of Chiappori (1988, 1992) using consumption expenditure data from Thailand. The unitary model can be tested based on the income pooling hypothesis that only total household income affects household demands for consumption of goods, while the general collective model can be tested based on implications of the Pareto efficiency hypothesis.

I have chosen to focus on testing these two models for two main reasons. First, testing the unitary model seems to be a sensible first step to study the household behavior. If we cannot reject the income pooling hypothesis, then modeling the household as an individual may be advantageous because the approach is simple and convenient. Second, testing the general collective model does not require the estimation of threat points as required by the bargaining models. This is important for an empirical purpose because estimating threat points requires a cardinal representation of preferences.

During the past two decades, several empirical studies have rejected the unitary model focusing on either labor supply or on consumption demand. Schultz (1990) tests for the determination of husband and wife labor supply and fertility using unearned income based on the 1981 Socioeconomic Survey of Thailand. He rejects the prediction of the unitary model that variables measuring the unearned income of the husband and the wife have equal coefficients in the wife's labor supply equation. He finds that women prefer to consume more leisure time when their unearned income increases but the effect for men's labor supply is not statistically significant. Moreover, unearned income owned by the wife is significantly related to higher fertility, and this effect is not evident for husband's unearned income.

Thomas (1990) uses survey data on family health and nutrition in Brazil for 1974-1975 to reject the unitary model prediction of the equality of parental income effects. He shows that unearned income received by a mother has a much larger positive effect on the health of family members than does unearned income received by a father. Moreover, the unitary model is also rejected for gender preference when considering household resource allocations on child anthropometric indicators. He finds that mothers prefer to devote resources to improve the heights and weights of their daughters, while fathers prefer to do the same for their sons.

Bourguignon et al. (1993) use French household survey data in 1984-1985 to study models of intrahousehold allocation focusing on household consumption expenditures. Initially, they plan to analyze the behavior of couples without children because children and expenditure on them may be considered as public goods by both parents, while the model analyzed in their paper only allows for private goods. However, it turns out that considering only childless couples leads to too small of a sample size. For this reason, they also include couples with one child in the sample which still provides only 843 households. Complying with the fixed labor supply model by analyzing the effects of exogenous incomes on consumption expenditures, they are able to reject the unitary model that individual incomes have no effect on how household resources are allocated. Conversely, they are unable to reject the collective model which suggests that actual behavior may prove not to be inconsistent with the cooperative hypothesis.

Thomas and Chen (1994) use individual and household incomes from household budget survey data in Taiwan in year 1980 to test the unitary and collective models focusing on ten expenditure groups. They examine three samples separately; the first sample contains a full sample of all 14,697 households; the second sub-sample includes only those households with both male and female head present; and the third sub-sample restricts the sample to include only those who live in urban areas. They also examine a series of empirical Engel curves; each includes only non-labor income which is treated as exogenous, or total income (labor and non-labor) which is treated as endogenous. Overall, the evidence indicates that the unitary model is not consistent with Taiwanese data while the collective model performs very well with the data for each pair of goods. However, these results rely critically on the assumption that total income is not exogenous. When total income is not instrumented, the collective model is rejected for 19 of 45 pairs of goods. The difference in results illustrates that the assumptions used when specifying and estimating Engel curves can influence inferences about intrahousehold resource allocation.

Lundberg et al. (1997) use U.K. Family Expenditure Survey (FES) data for the period of 1973-90 to test the income pooling hypothesis based on a policy change in the U.K. that transferred a substantial child allowance from husbands to wives in the late 1970s. They consider expenditure patterns for families consisting of one child; two children; and three children. Childless couples are excluded because the wide age range of families (which include the elderly) is likely to result in expenditure patterns incomparable to those of households containing children. They use clothing expenditure as a prime category to examine the effect of a policy change because clothing expenditures are assignable to individual household members. The results clearly reject the income pooling hypothesis since there are significant changes in clothing expenditure patterns. For families with two or three children, there is a substantial increase in spending on women’s and children’s clothing relative to men’s clothing following the transfer of resources from men to women. There is no significant change in the one-child families, while for families with two and three children the differences are significant. The difference in results illustrates that conclusions about intrahousehold resource allocation may depend on household composition.

Ward-Batts (2008) uses micro level data to analyze how budget shares change before and after the same child benefit reform in the UK for the two-parent families with and without children as an extension of Lundberg et al. (1997). Her overall results support the findings by Lundberg et al. (1997) which reject income pooling. In addition, she finds one interesting result that the estimates of budget shares among married-couple households with no children do not show a similar pattern of change to that in households with children. The sample without children shows no change in broad goods expenditures, or in narrowly defined goods with the exception of tobacco categories. Other tobacco is the only good for which similar changes are found in households with and without children.

Unlike previous studies that often test unitary or collective models using only one or a few household types, I will test both models using a broader range of household types, including non-nuclear families. This emphasis on household composition fits particularly well with the traditional Thai society in which not only children but also other blood relatives live together in the same household. One important assumption imposed for the models estimated in this chapter is that each family must have only two income earners who are spouses while the remaining family members are dependents with no income. This restriction allows us to compare the results from this chapter with the results from previous studies that consider only the two-earner households, with the emphasis on the differences in results that may have been affected by household composition. This restriction will be relaxed in chapter two where I consider consumption allocation of multiple-earner households.

Let us begin by considering a household consisting of an earning couple with D dependents in which one of the spouses is a dictator who has an altruistic preference. Thus, the dictator determines all allocations to household members as if solving the problem

$$\underset{x^h, x^w, x^d}{Max} \quad U(x^h, x^w, x^d; a), \qquad d = 1, \ldots, D \tag{1.1}$$

subject to a budget constraint

$$p^h x^h + p^w x^w + \sum_{d=1}^{D} p^d x^d \; = \; y^0 + y^h + y^w \; = \; y$$

where $x^j (j = h, w, d)$ denotes consumption of a vector of goods by individual j (husband, wife, and the d^{th} dependent), x^d equals zero when the household has no dependents, a denotes a vector of individual and household characteristics, p^j denotes a vector of prices faced by individual j, y^j denotes exogenous income (full-time wage and salary in the labor market) of individual j, and y^0 represents exogenous joint household income (non-invested household income, e.g. assistance from other persons outside the household) .

Assuming that the utility function $U(.)$ is continuous and quasiconcave, and the second order sufficient condition is satisfied, then by the implicit function theorem we can solve the first-order conditions of problem (1.1) for the demand for good i by individual j, x_i^j . In general, x_i^j will depend on all prices p^h, p^w, and p^d denoted by p, and exogenous incomes y^0, y^h and y^w as well as individual and household characteristics a:

$$x_i^j \; = \; x_i^j (p, y^0, y^h, y^w; a) . \tag{1.2}$$

When only household consumption is observed, the household demand for good *i* can be written as:

$$x_i \;=\; x_i^h + x_i^w + \sum_{d=1}^{D} x_i^d \;=\; x_i\,(p, y^0, y^h, y^w; a)\,. \tag{1.3}$$

However, in the unitary model, whether income is received by husband or wife is irrelevant. The income pooling hypothesis predicts that household demand only depends on total household income, $y = y^0 + y^h + y^w$ as well as all prices and household characteristics. Then, the household demand for good *i* can also be written as:

$$x_i \;=\; x_i\,(p, y; a)\,. \tag{1.4}$$

Equation (1.4) implies that it does not matter who controls income in the household so that redistribution of income within the household should not affect household resource allocations. This suggests a simple test of the income pooling hypothesis that in the household demand function for good *i*, the marginal effects of husband's and wife's incomes should be zero. If the income pooling is rejected, hence the unitary model, then we should determine what other household model might be consistent with the data. Thus, I continue to test if the data is consistent with the general collective model.

Continuing with the assumption that a household consists of two spouses and any number of dependents, and assume further that each spouse has altruistic preferences in the sense that each cares about every member's consumption of goods. I also assume that all dependents only play a passive role in this model such that all consumption decisions are made by the spouses. Thus, I will treat dependents' consumptions as household public goods. Let dependents' consumptions and all other household public goods be represented by *X*, then any Pareto efficient allocations solves the problem:

$$\underset{x^h, x^w, X}{Max} \; U^h(x^h, x^w, X; a) \tag{1.5}$$

subject to

$$U^w(x^h, x^w, X; a) \;\; \geq \;\; \bar{u}^w$$

$$p^h x^h + p^w x^w + PX \;\; = \;\; y^0 + y^h + y^w \;\; = \;\; y$$

where $\bar{u}^w$ is some required utility level for the wife and *P* denotes a price vector for public goods. Thus, the maximization problem (1.5) seeks an allocation that maximizes the husband's welfare subject to a given welfare level required for the wife and to the household budget constraint. By varying $\bar{u}^w$, all Pareto efficient allocations can be traced out. This set of Pareto efficient allocations forms the boundary of the utility possibility set, which captures all attainable vectors of utility levels for the household.

According to Chiappori (1992) and Vermeulen (2002), the household allocation problem (1.5) is equivalent to the following maximization problem:

$$\underset{x^h, x^w, X}{Max} \;\; \mu U^h(x^h, x^w, X; a) + (1-\mu) U^w(x^h, x^w, X; a) \tag{1.6}$$

subject to

$$p^h x^h + p^w x^w + PX \;\; = \;\; y$$

where $0 < \mu < 1$.[1] In this social welfare context, welfare weights μ and (1- μ) are attached to both husband and wife. In general, the weighting function μ will depend on the exogenous variables which can be written as:

$$\mu = \mu(p^h, p^w, P, y^0, y^h, y^w, a) . \tag{1.7}$$

These welfare weights play an important role in this model. An interpretation of these welfare weights is that they represent the bargaining power of the spouses in the intrahousehold allocation process. Changes in prices, exogenous incomes or household characteristics may shift bargaining power from one spouse to another. Solving maximization problem (1.6) yields the demand for any private good, x_i, and the demand for any public good, X_m, as a function of prices, total household income and the household characteristics as well as the welfare weight, μ:

$$x_i \;=\; x_i\,(p^h, p^w, P, y, a, \mu) \tag{1.8}$$

$$X_m \;=\; X_m(p^h, p^w, P, y, a, \mu) . \tag{1.9}$$

Since we have the data on each spouse's individual income y^h and y^w, then we can differentiate the demand function (1.8) with respect to y^h and y^w to obtain:

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[1] To see this, note that the Lagrangian function of the maximization problem (1.5) equals:

$$U^h(x^h, x^w, X; a) + \delta[U^w(x^h, x^w, X; a) - \bar{u}^w] + \lambda[y^0 + y^h + y^w - p^h x^h - p^w x^w - PX].$$

Multiplying this Lagrangian function by $\dfrac{1}{1+\delta}$, results in

$\mu U^h(x^h, x^w, X; a) + (1-\mu)U^w(x^h, x^w, X; a) + \rho[y^0 + y^h + y^w - p^h x^h - p^w x^w - PX]$ where $\mu = \dfrac{1}{1+\delta}$ and $\rho = \dfrac{\lambda}{1+\delta}$ and where the unimportant constant $\bar{u}^w$ for the maximization problem has been eliminated. See Vermeulen (2002).

$$\frac{\partial x_i}{\partial y^h} = \frac{\partial x_i}{\partial y}\frac{\partial y}{\partial y^h} + \frac{\partial x_i}{\partial \mu}\frac{\partial \mu}{\partial y^h} \tag{1.10}$$

$$\frac{\partial x_i}{\partial y^w} = \frac{\partial x_i}{\partial y}\frac{\partial y}{\partial y^w} + \frac{\partial x_i}{\partial \mu}\frac{\partial \mu}{\partial y^w} \tag{1.11}$$

By dividing (1.10) by (1.11) holding total household income constant, the ratio of any two income effects can be written as

$$\frac{\partial x_i / \partial y^h}{\partial x_i / \partial y^w} = \frac{\partial \mu / \partial y^h}{\partial \mu / \partial y^w} \tag{1.12}$$

which is independent of *i* for private good.

Similarly, we can differentiate the demand function (1.9) with respect to y^h and y^w to obtain:

$$\frac{\partial X_m / \partial y^h}{\partial X_m / \partial y^w} = \frac{\partial \mu / \partial y^h}{\partial \mu / \partial y^w} \tag{1.13}$$

which is independent of *m* for public good.

Thus, (1.12) and (1.13) provide a straightforward test for Pareto efficiency which is a simple way to test the validity of the general collective model. They imply that the ratio of husband income effects to wife income effects will be the same across all pairs of goods.

1.4. Data

The data comes from the Socio-Economic Survey (SES) conducted by National Statistical Office of Thailand (NSO) on a sample of about 52,000 households in year 2006. The SES has been carried out every two years. The objective of the survey is to collect economic and social information about households such as income, expenditures, housing characteristics, ownership of selected durable goods and changes in assets and liabilities, for measuring the variation in levels of living and disparities among households in different socioeconomic groups and geographic areas. All sample households were divided into 12 equally representative sub-samples, and each sub-sample household group was interviewed about economic and social information for a one month period, from January to December 2006. The survey covered all private, non-institutional households residing permanently in municipal areas and non-municipal areas of all 76 provinces from five regions of Thailand. However, it excluded the population living in transient hotels and rooming houses, hostels, boarding schools, or living in institutions such as temples, military barracks, prisons, welfare institutes, hospitals and other such institutions. It also excluded households of foreign diplomats and other temporary residents.

Dependent variables are monthly consumption expenditures for each of 12 categories. This excludes expenditures on durable goods such as automobiles, televisions, refrigerators, household furniture.[2] For each category, the survey records the consumption data in terms of last month expenditures on more frequently purchased goods, while recording monthly average of expenditures during the past 12 months for less frequently purchased goods. This data recording technique helps to avoid the problem of households recording zero consumption on some infrequently purchased goods that are not 'true' zeros as pointed out by Phipps and Burton (1998).

The survey records three measurements of spouses' incomes depending on how the questions are written in the survey. The first question is a direct question asking how much each

[2] I choose to exclude expenditures on durable goods from monthly consumption expenditures because total consumption expenditure may be higher in periods when households purchase durable goods so that it may not represent the usual household's consumption patterns. However, the overall results are similar when including durable goods to monthly consumption expenditures, and are available upon request from the author.

spouse typically earns from their jobs per month. The second question asks how much they actually received from their jobs last month. The third question asks how much they actually received from their jobs during the past 12 months. In order to obtain an average monthly income from the third question, I divide the income received during the past 12 months by the actual length of the working period. The data show that the correlations among these three measurements of monthly incomes are significantly high: 0.96 between direct and last month questions, 0.98 between direct and average monthly questions, and 0.95 between last month and average monthly questions. In this chapter, I choose to use incomes recorded from the direct question because that is normally the amount people deem to possess in Thai society. Moreover, workers in some occupations may have not yet received last month payments during the month of the interview. Using incomes from the direct question also has an advantage of reducing a number of workers reporting zero income compared to the case where the question of the actual incomes received last month had been chosen.

Level of education is recorded as the highest level of official educational attainment, so I convert each level of official education attainment into official years in school. Age is recorded up to subject's last birthday. Household size accounts for everyone excluding maids and servants, while children variables account for the number of younger children (aged less than five years) and older children (aged between 6 to 14 years) living in the same residence. Ownership dummies correspond to whether households own houses or vehicles. Regional dummies indicate residence in Bangkok or other regions of Thailand, and the urban dummy denotes residence in a municipal area.

To be consistent with the model presented in the previous section, the sample is limited to households consisting of a married couple with one spouse recorded as head of the household, living with or without dependents of all ages. Both spouses are full-time employees who work for a minimum of 35 hours per week outside their home, and no one other than these spouses is reported to have any income. This results in a total sample size of 2933 households. Table 1 provides overall descriptive statistics for this sample.

1.5. Empirical model of household expenditures and results

Before testing the validity of the predictions of the unitary against the collective models, let us first assume that households behave according to the unitary model. This implies that only total household income, and not the separate incomes of individual members, will affect household demands.

Following Bourguignon et al. (1993), without price variation, the individual Engel curves for all 12 categories for the unitary household model are assumed to have the following quasi-quadratic form:

$$C \;=\; \alpha + \beta_t y^t + \beta_{tt}(y^t)^2 + \sum_g \beta_g a_g + u \tag{1.14}$$

where C represents the 12 categories of consumption expenditures on private and public goods, a includes g demographic variables including household size, number of young and older children, ownership of houses and vehicles, age and level of education of both spouses, urban and regional dummies, and where u is a disturbance. Notice that parameters in Equation (1.14) vary over goods whereas variables and the disturbances vary over goods and across households. The household and good subscripts are suppressed to simplify notation. Table 2 provides the estimates from the system of equations using the seemingly unrelated regression estimation (SURE) for the full sample size of 2933 households.

The results in Table 2 show that consumption expenditure data from Thailand fits well with the quasi-quadratic form by looking at the R-squared values. Ten of 12 categories have R-squared values exceeding 0.22 and the only two categories that have low R-squared values are health, and alcohol and tobacco. The coefficient on household size is positive and significant at the 1% on seven categories, while it is insignificant on four, and negatively significant at 5% only on the alcohol and tobacco category. The results are sensible because larger households are expected to spend more on goods like housing, household operations, and food, requiring them to cut back on some of non-essentials like alcohol and tobacco.

The presence of children has a significant impact (mostly negative) on all but one consumption categories at the 10% level of significance or lower, after removing effects of household size. It provides additional supports to Browning (1992)'s argument that household economic behavior is significantly correlated with the presence of children, especially when we look at the effects of children on household food consumption both at home and outside of home. Results indicate that couples without children and those with varying numbers of children differ in how they allocate their resources. For example, the results show that couples with more children spend more on food at home and less on food outside of home than do couples with fewer or no children. Moreover, younger children tend to increase the expenditure on personal and services category, possibly because mothers who work full time may require more help (day care), while older children tend to increase the expenditures on clothing and footwear, and cosmetic products.

When looking at the demographic influences, higher-educated spouses tend to spend more on almost all categories, while ages of spouses have no significant impact on their consumption patterns. People living Bangkok clearly spend more on most categories than people living in other regions, except for cosmetic and alcohol and tobacco products. Foods are more expensive in the municipal than rural areas.

The coefficient on total income is significant at 1% on all categories, while the coefficient on total income square is significant on nine categories. Using these highly significant income coefficients, we can calculate income elasticities, E_Y, to determine which categories can be considered inferior or normal goods.[3] When evaluated at the mean total household income (23,059 baht), 11 out of 12 categories can be considered normal goods, while the only inferior good is cosmetic. When evaluated over the income distribution, only six categories can be considered normal goods at all income levels because both β_t and β_{tt} are positive. These categories are housing, household operation, clothing and footwear, transportation and communication, education, and recreation and religion. Personal and services, and cosmetic are considered inferior goods up to where household income levels reach 22,058 baht and 34,960 baht, respectively, and then become normal goods. Health, food at home, food outside, and alcohol and tobacco are considered normal goods up to where household income levels reach

[3] The income elasticities E_Y is equal to $(\beta_t + 2\beta_{tt} y_t)\frac{y_t}{C}$. The critical income level that switch goods from normal to inferior goods (when $\beta_t > 0$ and $\beta_{tt} < 0$), or from inferior to normal goods (when $\beta_t < 0$ and $\beta_{tt} > 0$) is $y_t = \frac{-\beta_t}{2\beta_{tt}}$.

152,440 baht, 249,919 baht, 1,436,950 baht, and 140,483 baht, respectively, and then become inferior goods.[4]

Next, I will estimate the unitary model using another specification of the Engel curve developed by Banks et al. (1997) to see whether the results are similar to those obtained using the quasi-quadratic form. They propose what they call the Quadratic Almost Ideal Demand System (QUAIDS) which generalizes the Almost Ideal (AI) model of Deaton and Muellbauer (1980) for more flexibility by having both linear and quadratic log total expenditure as the leading terms. The reasons why I choose to consider another specification of the Engel curve is to address three problems resulting from relying solely on the quasi-quadratic form. First, the quasi-quadratic is not consistent with utility maximizing behavior, whereas the QUAIDS is. Second, the quasi-quadratic form, while frequently used to test the unitary model, is rarely used by researchers who apply the unitary model to study household expenditures. Third, income effects often vary as income levels change, and thus inferences may differ according to the functional form used to represent nonlinear effects of income on demand (Banks et al. 1997).

Without price variation, the QUAIDS for unitary model takes the following form of the expenditure share equation system:

$$w \; = \; \gamma + \beta_E \ln E + \beta_{EE} (\ln E)^2 + \sum_g \beta_g a_g + v \tag{1.15}$$

where w represents shares of consumption expenditures on each good, E represents total household consumption expenditure, a includes g demographic variables as described earlier, and where v is a disturbance. For simplification, notice again that parameters in Equation (1.15) vary over goods whereas variables and the disturbances vary over goods and across households.

[4] However, these income levels are way at the top end (0.001%) of the sample distribution.

Since the shares of consumption expenditures from the Engel curve (1.15) sum up to one, we have to omit one of the consumption categories in order to perform SURE. In this case, I choose to omit the health category from the systems of equations to accommodate the adding up restriction of the underlying model of utility maximization subject to a linear budget constraint.[5] Table 3 provides the estimates from the systems of equations corresponding to the Engel curve (1.15) for 11 consumption categories for the full sample size of 2933 households.

In general, the results in Table 3 show that Thai data do not fit as well with the Engel curve (1.15) as with the Engel curve (1.14) specifications. Of course, the two equation systems consider different dependent variables, so comparisons of R-squared are of limited value. However, the coefficients on most household characteristics including children variables have similar signs in both specifications. This is helpful for our analysis since the results do not show a lot of variation due to the difference in model specifications. However, when looking at the demographic influences, having higher education does not have much impact on consumption behavior compared to results in Table 2, while ages of spouses still have little significant impact, except for food outside of home. Another interesting finding is that people living outside Bangkok tend to spend higher expenditure shares on food at home and on alcohol and tobacco consumption.

The coefficients on log total expenditure and its squared term are significant in almost all categories. When estimating total expenditure elasticities, E_E, evaluated at the means of log total household expenditure and expenditure shares for each category, all categories can be considered

[5] Theoretically, the results should be invariant to which share of consumption omitted. However, Barten (1969) proves that the results are invariant only if the model is estimated by maximum likelihood estimation. Thus, I reestimate the system of equations using the iterated SURE which converges to the maximum likelihood results and find the coefficients from iterated SURE are very similar to those obtained from SURE.

as normal goods (all E_E are positive).[6] This implies that households increase expenditure shares on each good when total household expenditure increases, holding other expenditure shares constant.

However, there is a reason to suspect that total consumption expenditure may be endogenous with respect to shares of household consumption expenditure, especially for infrequently purchased goods. Consequently, total consumption expenditure may be higher in periods when infrequently purchased goods are purchased than in periods when they are not. This may not be as problematic in our case because the SES does record the infrequently purchased goods as average monthly expenditures during the past 12 months. When testing for exogeneity of log total expenditure and its square in each category, I find that it is rejected for six categories. Thus, I proceed to perform the 3SLS using log total income and its square to instrument for log of total expenditure and its square. In addition to log total income and its square, I also include all the explanatory variables, financial assets, debt dummy, and household nonconsumption expenditure in the instrument set. The minimum eigenvalue statistic of 198.267 rejects the hypothesis of weak instruments at 5% level of significance. Moreover, we cannot reject the overidentifying restrictions in almost all consumption categories. This should provide us with at least some confidence that our choices of instruments are valid. Table 4 provides the 3SLS estimates corresponding to the Engel curve (1.15) for 11 consumption categories for the full sample size of 2933 households.

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[6] The expenditure elasticities E_E is equal to $1+\frac{1}{w}\left[\beta_E + 2\beta_{EE}(\ln E)\right]$. Since there are two variables, w and $\ln E$, in the formula, then we cannot exactly determine the critical expenditure level that switch goods from normal to inferior goods and vice versa.

In general, the 3SLS estimates show some variations in the significance levels of the coefficients compared to those reported in Table 3. However, there is no switch in signs between coefficients except for only the northeast coefficient in the transportation and communication category. Thus, there is little qualitative difference whether or not we instrument for total consumption expenditure and its square terms.

Now, I proceed to test the validity of the predictions of the unitary against the collective models by adding individual income terms to the Engel curves (1.14) to get

$$C = \alpha + \beta_h y^h + \beta_w y^w + \beta_t y^t + \beta_{hh}(y^h)^2 + \beta_{ww}(y^w)^2 + \beta_{tt}(y^t)^2 + \beta_{hw} y^h y^w + \sum_g \beta_g a_g + u \quad (1.16)$$

where C represents the 12 categories of consumption expenditures on private and public goods, a includes g demographic variables including household size, number of young and older children, ownership of houses and vehicles, age and level of education of both spouses, urban and regional dummies, and where u is a disturbance. Notice again that parameters in Equation (1.16) vary over goods whereas variables and the disturbances vary over goods and across households. The household subscript is suppressed to simplify notation.[7] Table 5 provides the estimates from the system of equations using SURE for all 12 consumption categories for the full sample size of 2933 households.

After adding more income variables to the quasi-quadratic Engel curves, the results in Table 5 are very similar to those from Table 2, especially by looking at the R-squared values. Moreover, most demographic coefficients have not only the same significance levels but also the signs and magnitudes. The coefficients on household total income and its square are less significant in Table 5, which may be caused by adding more income variables to the model.

[7] Equation (1.16) has the exact same functional form estimated by Bourguignon et al. (1993).

In equation (1.16), $\frac{\partial C}{\partial y^t} = \beta_t + 2\beta_{tt} y^t$ is estimated holding y^h and y^w constant and corresponds to the effect of a one-unit (100 baht) increase in y^0 (because $y^t = y^h + y^w + y^0$). Also, $\frac{\partial C}{\partial y^h} = \beta_h + 2\beta_{hh} y^h + \beta_{hw} y^w$ is estimated holding $dy^t = dy^w = 0$ and corresponds to the effect of $dy^h = -dy^0$, that is, to a one-unit increase in the husband's income that is exactly offset by a one-unit decrease in non-labor income. Similarly, $\frac{\partial C}{\partial y^w} = \beta_w + 2\beta_{ww} y^w + \beta_{hw} y^h$ is estimated holding $dy^t = dy^h = 0$ and corresponds to the effect of $dy^w = -dy^0$. The income pooling hypothesis states that a change in the relative income of the husband and wife has no effect on demand if total household income is constant. For this to be true at arbitrary levels of y^h and y^w, it must be true that $\beta_h = \beta_w = \beta_{hh} = \beta_{ww} = \beta_{hw} = 0$. Imposing these five restrictions on 12 expenditure categories gives a total of 60 restrictions. Rejection of these restrictions implies that income is not pooled and the unitary model may not be appropriate in explaining household resource allocation behavior.

When imposing a total of 60 restrictions to the systems of Engel curves (1.16) that husband's and wife's individual incomes are irrelevant, a chi-square value of 498.99 clearly rejects the income pooling hypothesis at the 1% significance level. This finding supports the results found from previous studies described in Section 1.3 which also reject income pooling. However, the rejection of income pooling in Table 5 may be due to the fact that almost 38% of our sample is households consisting of spouses only, which is similar to what most previous studies have considered using data from developed countries. None of the previous studies has considered households with more than two generations living in the same residence which is fairly common in Thailand. Thus, I continue to test income pooling for each household type separately to see if the results still hold for each household type.

Before proceeding to examine the behaviors of different household types, I will also test the validity of the predictions of the unitary against the collective models using QUAIDS specification by adding log individual income terms to the Engel curves (1.15) to get

$$w = \gamma + \beta_E \ln E + \beta_{EE} (\ln E)^2 + \beta_h \ln y^h + \beta_w \ln y^w + \sum_g \beta_g a_g + v \tag{1.17}$$

where w represents shares of consumption expenditures on each good, E represents total household consumption expenditure, a includes g demographic variables as described earlier, and where v is a disturbance. Notice again that parameters in Equation (1.17) vary over goods whereas variables and the disturbances vary over goods and across households.

From the Engel curve (1.17), we can test the income pooling hypothesis that only total expenditure has an effect on household consumption behavior while individual sources of income are irrelevant. For each consumption category, this is the same as testing the restrictions that $\beta_h = \beta_w = 0$. I choose to omit the health category from the systems of equations to accommodate the adding up restriction of the QUAIDS. Table 6 provides the estimates from the systems of equations corresponding to the Engel curve (1.17) for 11 consumption categories for the full sample size of 2933 households.

The estimates in Table 6 are extremely similar to the estimates found in Table 3, including the signs, magnitudes and level of significance. When considering the coefficients on spouses' incomes, the coefficients on log husband and wife incomes are significant in seven categories under this specification, while the coefficients on log total expenditure and its squared term are significant in almost all categories. When imposing a total of 22 restrictions that individual sources of income are irrelevant in the QUAIDS, i.e., $\beta_h = \beta_w = 0$ for 11 categories, a chi-square value of 157.75 clearly rejects income pooling for Thai data at 1% level of significance.

When testing for exogeneity of log total expenditure and its square in each category, I find that it is convincingly rejected in all categories. Thus, I proceed to perform the 3SLS using log total income and its square to instrument for log of total expenditure and its square. In addition to log total income and its square, I also include all the explanatory variables, financial assets, debt dummy, and household nonconsumption expenditure in the instrument set. The minimum eigenvalue statistic of 19.51 rejects the hypothesis of weak instruments at 5% level of significance. Moreover, we cannot reject the overidentifying restrictions in almost all consumption categories. This should provide us with at least some confidence that our choices of instruments are valid. Table 7 provides the 3SLS estimates corresponding to the Engel curve (1.17) for 11 consumption categories for the full sample size of 2933 households.

In general, the 3SLS estimates in Table 7 show some variations in the significance levels of the coefficients compared to those reported in Table 6. There is no switch in signs between coefficients except for only the log husband wage in food at home category, and the log total consumption squared term in the housing category. Thus, there is little qualitative difference whether or not we instrument for total consumption expenditure and its square terms. Moreover, a chi-square value of 59.70 also rejects income pooling at the 1% level of significance. Thus, the results from both Engel curve specifications (1.16) and (1.17) clearly reject the unitary model for household consumption expenditures in the two wage-earner households in Thailand.

Next, in order to compare the differences between the results in this chapter to those from previous studies, I continue to estimate the Engel curves for each subsample for various household compositions separately. Seven subsamples are estimated by equations (1.16) and (1.17) which include households consisting of spouses with various types of dependents. Since we rejected the exogeneity of log total expenditure and its square, I only report the testing results using the 3SLS estimates for the QUAIDS specification. Table 8 provides the results for the test of the income pooling hypotheses for all subsamples.[8]

The results in Table 8 show that the income pooling can be rejected for all seven subsamples with the specification (1.16), but can be rejected for only four subsamples with (1.17). This is an interesting finding because our specification (1.16) is more parallel to what has been done by most previous studies that consider household consumption in terms of money expenditures rather than shares of total expenditures. In such case, the results in this chapter are consistent with results from previous studies for all types of households with or without any dependents. These confirm that the unitary model is still not very attractive to explain household consumption behaviors in Thailand.

On the other hand, the QUAIDS Engel curve (1.17) only rejects the income pooling for households consisting of fewer than four members. These findings clearly suggest that the number of dependents makes the difference on how households allocate their shares of consumption expenditures. Thus, households with different compositions should be examined separately on how their household resources are allocated. Considering all types of households together may lead to various results depending on the proportions of each household type in the

[8] See Appendix A and Appendix B for estimates of each subsample for Engel curves (1.16) and (1.17).

sample. When considering each household type separately, households with more dependents seem to behave consistently with the prediction of the unitary model. A possible explanation is that once there are dependent individuals living in the household, these dependents can be considered as household public goods as described earlier in the model. Both spouses would be likely to spend higher shares of their individual incomes on these dependents' consumptions and have less money to spend freely for their own interests; thus, making it harder to reject the income pooling hypothesis.

For example, the share of food consumed at home increases with the number of dependents while the share of food consumed outside declines. Couples with no dependents can very well behave just like two separate individuals sharing rents and utility bills. Once the household size gets larger, the shares of household public goods also get larger because there are only two income earners. Couples with dependents may consult each other more on how to allocate their resources and thus pool their incomes as opposed to couples without any dependent. Thus, it is possible that the unitary model may apply when there are many household public goods to be considered in the households which are the number of dependents in this case.

Having rejected the unitary model for the full sample and most subsamples, I now test the general collective model of Chiappori (1988; 1992) that husband and wife choose a Pareto efficient allocation of resources. Testing the Pareto efficiency is the same as testing the non-linear restrictions that the ratios of husband and wife income effects are the same across all pairs of consumption categories.[9] Table 9 provides the results of testing the Pareto efficiency using the systems of equations regression for all subsamples.

[9] See Eqs. (1.12) and (1.13).

Table 9 shows that Pareto efficiency is not rejected at the 5% level in any subsample using either Engel curve specification. These results suggest that all household types in Thailand behave consistently with the Pareto efficient hypothesis as suggested by Bourguignon et al. (1993) using French and by Thomas and Chen (1994) using Taiwanese data. Therefore, we may conclude that the general collective model is more attractive than the unitary model in explaining intrahousehold resource allocation behaviors regardless of the specification of the Engel curve.

1.6. Conclusions

This chapter tests the unitary and general collective models of intrahousehold resource allocations using consumption expenditure data from Thailand. The main difference of this chapter from previous studies is that it looks at the application of these models for various household compositions since most studies in the literature have rejected the unitary model using data from nuclear families.

However, most previous studies using consumption expenditure data have used data from developed countries. Prior research indicates that household composition has a substantial effect of consumption expenditures and suggests that the outcome of tests of the unitary model may differ according to household composition. Household composition differs between developed and developing countries. Households tend to be larger and non-nuclear families are more common in developing countries. Thus, I test the unitary and collective models separately for different types of households.

I find that, for the quasi-quadratic Engel curve specification, the overall results support the previous findings in the literature that the unitary model fails to explain how the resources are allocated for all household types. However, when using the QUAIDS, the unitary model is rejected only for smaller-sized households. These are households consisting of fewer than four members. These findings bring up two interesting concerns from testing the unitary model. First, different Engel curve specifications affect the results. Second, the presence of dependents in the households, such as children, appears to affect how resources are allocated within the households.

The general collective model, on the other hand, cannot be rejected in any subsample for either quasi-quadratic or QUAIDS functional forms. This finding supports the perspective of the general collective model that household members may have different preferences but allocate their resources efficiently. The results in this chapter indicate that the general collective model of household behavior is more attractive than the unitary model.

Finally, even though the general collective model appears to be more theoretically and empirically attractive, all results in this chapter are restricted to only two wage-earner households with two distribution factors which are spouses' individual incomes. Since the idea of extended families is fairly common in most developing countries, there are opportunities for future research to examine households consisting of multiple earners with more distribution factors to see if the general collective model still performs well under such circumstances.

CHAPTER TWO: DO THAI HOUSEHOLDS WITH MULTIPLE DECISION MAKERS BEHAVE PARETO EFFICIENTLY?

2.1. Introduction

The standard economic model to explain how a household chooses to allocate resources among its members is the unitary model. The unitary model generally considers the household as a single decision-making unit in which all household members reach consensus and thus can be represented by one common preference (Samuelson 1956). Another justification for this model is that there is a dictator who determines all allocations from the point of view of an altruist who cares about other household members (Becker 1981). Because of its simplicity and convenience the unitary model had been applied in many studies both theoretically and empirically.

The unitary model has been seriously challenged during the past two decades, however, based on its weak theoretical foundation that we can analyze households as a single decision-making unit. Using this assumption, we can apply Neo-classical utility theory to the household setting and ignore the possibility that each individual in the household has unique preferences. The unitary model also has been challenged by many empirical studies that reject restrictions on the Slutsky matrix (Browning and Chiappori 1998) or reject the income pooling hypothesis (Schultz 1990; Thomas 1990; Bourguignon et al. 1993; Thomas and Chen 1994; Lundberg et al. 1997; Phipps and Burton 1998). For example, Browning and Chiappori (1998) reject the symmetry property of the Slutsky matrix for Canadian couples but not for single men and women. This result suggests that the rejection of the symmetry property is due to having the incorrect model for couples and is not attributable to the specification of the model. However, the results from chapter one show that, without price variation, the rejection of the income pooling depends on the specification of the estimated Engel curves for households with two decision makers in Thailand. These findings suggest that the rejections of the unitary model may be due to having either the incorrect model or inadequate functional forms or both.

On the other hand, the general collective model developed by Chiappori (1988, 1992), which is the main alternative to the unitary model, works well empirically in explaining household decision behaviors for various model specifications using consumption survey data from different countries. More importantly, the general collective model is very theoretically attractive because it allows each household member to have distinct preferences and only assumes that the final outcomes are Pareto efficient.

Up to now, only a small number of studies have used consumption expenditure data to test the validity of the general collective model (Bourguignon et al. 1993; Thomas and Chen 1994). However, these previous studies only test the Pareto efficiency hypothesis for households consisting of two decision makers. None has tested the Pareto efficiency for households with multiple decision makers. The latter case is important because it is very common in many developing countries that households consist of at least two or three generations of blood relatives living together as extended families. Thus, it may be worthwhile to determine whether the general collective model applies to households in which decisions may be more complex than in households with only two decision makers.

This chapter generalizes tests for Pareto efficiency for application to households with more than two decision makers, by applying the concept of distribution factors. Distribution factors are variables that affect the household decision process but do not affect either individual preferences or the household budget constraint. Some examples of distribution factors have been suggested in prior studies (e.g. McElroy 1990; Lundberg and Pollak 1993; Browning et al. 1994; Lundberg et al. 1997; Chiappori et al. 2002; Dauphin et al. 2003; Bourguignon et al. 2009) are individual incomes, relative incomes of household members, the regional sex ratio, personal attractiveness, marriage and divorce laws, child support law where individual incomes are the most common distribution factor used in the literature. According to Bourguignon et al. (2009), these distribution factors will play a major role in the following three reasons. First, the existence of such variables is inconsistent with the unitary model. Second, without price variation, the influence of distribution factors provides the only testable restrictions for the collective model. Third, distribution factors are helpful in recovering some features of the intra-household decision process; this point will be discussed in the next chapter. This chapter extends the model used in chapter one to derive the testable restrictions on the collective model for households with any number of decision makers using the unconditional demand systems approach.

The chapter is organized as follows: Section 2.2 develops the theoretical framework and provides testable restrictions on the collective model for households with more than two decision makers using the unconditional demand systems. Section 2.3 introduces the concept of conditional demand systems and its application. Section 2.4 describes the sample. Section 2.5 outlines the empirical model of household expenditures estimated in the chapter and presents empirical results. Finally, conclusions are provided in Section 2.6.

2.2. The theoretical framework

Let us begin by considering a household consisting of H+1 members (with $H \geq 1$) with no household production. Each member h, with h = 1, …, H+1, chooses his or her consumption of N

market goods that can either be consumed privately or publicly. To minimize the assumptions on individual preferences and to allow externalities within the household, assume that all H+1 members have altruistic preferences represented by $U_h(\mathbf{q_1},...,\mathbf{q_{H+1}},\mathbf{Q};\mathbf{a})$, where $\mathbf{q_h}$ denotes a vector of private consumption by the h^{th} member and **Q** denotes a vector of public consumption, and **a** denotes a vector of individual and household characteristics. The total household consumption can be written as $\sum_{h=1}^{H+1}\mathbf{q_h}+\mathbf{Q}=\mathbf{q}$. Since there is no price variation, we can normalize all prices to one so that the household budget constraint is given by $\mathbf{e}'(\sum_{h=1}^{H+1}\mathbf{q_h}+\mathbf{Q})=\mathbf{e}'\mathbf{q}=x$, where **e** is a unit vector of dimension N and x can be considered either as total household income or, as in the standard analysis of demand, total household expenditure.

Since we allow individual preferences to be different, we need to specify how households decide to consume **q** given the household budget constraint. In general, the household's decisions do not depend only on individual preferences but also on each member's decision-making power. Moreover, apart from the individual and household characteristics, these decision-making powers may also depend on distribution factors mentioned earlier. According to Chiappori et al. (2002), Dauphin et al. (2003) and Bourguignon et al. (2009), a variable z_k is a distribution factor if it affects the choices of $\mathbf{q_h}$ and **Q** directly through the weighting factors but does not have any effect through preferences or the household budget constraint. More importantly, the effects of distribution factors on consumption decisions provide the only testable restrictions for the collective model of household behavior where there is no price variation. Therefore, for all Pareto efficient allocations the household maximizes the problem:

$$\underset{\mathbf{q_1},\ldots,\mathbf{q_{H+1}},\mathbf{Q}}{Max}\ \boldsymbol{\mu}(x,\mathbf{a},\mathbf{z})'\,[U_1(\mathbf{q_1},\ldots,\mathbf{q_{H+1}},\mathbf{Q};\mathbf{a}),\ldots,U_H(\mathbf{q_1},\ldots,\mathbf{q_{H+1}},\mathbf{Q};\mathbf{a})] + \gamma\ U_{H+1}(\mathbf{q_1},\ldots,\mathbf{q_{H+1}},\mathbf{Q};\mathbf{a}) \quad (2.1)$$

subject to a budget constraint

$$\mathbf{e}'(\sum_{h=1}^{H+1}\mathbf{q_h} + \mathbf{Q}) = x$$

where $\boldsymbol{\mu}(x,\mathbf{a},\mathbf{z})' = [\mu_1(x,\mathbf{a},\mathbf{z}),\ldots,\mu_H(x,\mathbf{a},\mathbf{z})]$ and $\gamma = 1 - \sum_{h=1}^{H}\mu_h(x,\mathbf{a},\mathbf{z})$ represent each household member's welfare weights, and **z** is a *K*-vector of distribution factors. The distribution factors influence the weight of each member's preferences in household decisions. If individual income is a distribution factor, for example, members who have lower incomes may be more willing to compromise than those who have higher incomes. In that event, the outcomes of household decision process are likely to favor those with higher incomes and thus decision-making powers, as reflected in larger values of the welfare weights.

Assuming that each the utility function $U_h(.)$ is continuous and quasiconcave, and the second order sufficient condition is satisfied, then by the implicit function theorem we can solve the first-order conditions of problem (2.1) for the demand function for good *j* by the h^{th} member as a function of individual and household characteristics **a** as well as distribution factors **z**:

$$q_h^j \;=\; q_h^j(x,\mathbf{a},\mu_1(x,\mathbf{a},\mathbf{z}),\ldots,\mu_H(x,\mathbf{a},\mathbf{z})) \qquad , h = 1, \ldots, H+1. \quad (2.2)$$

When only household consumption is observed, the household demand for good *j* can be written as:

$$q^j \;=\; \sum_{h=1}^{H+1} q_h^j = q^j(x,\mathbf{a},\mu_1(x,\mathbf{a},\mathbf{z}),\ldots,\mu_H(x,\mathbf{a},\mathbf{z})). \quad (2.3)$$

The expression of Eq. (2.3) is very useful for our analysis because it can be used to represent both private and public consumption through index *j*.

To consider the influence of distribution factors on consumption behavior, let us differentiate (2.3) with respect to z_k to obtain

$$\frac{\partial q^j}{\partial z_k} = \sum_{h=1}^{H} \frac{\partial q^j}{\partial \mu_h} \frac{\partial \mu_h}{\partial z_k}, \tag{2.4}$$

for all $k = 1, \ldots, K$.

We can rewrite (2.4) into the matrix forms to get

$$\mathbf{q}_{\mathbf{z}}^j = \mathbf{M}\mathbf{q}_{\boldsymbol{\mu}}^j \tag{2.5}$$

where $\mathbf{q}_{\mathbf{z}}^j$ is a Kx1 vector of partial derivatives of q^j with respect to z_k; **M** is a KxH matrix of partial derivatives of μ_h with respect to z_k; and $\mathbf{q}_{\boldsymbol{\mu}}^j$ is an Hx1 vector of partial derivatives of q^j with respect to μ_h.

Assuming that not every element of the vector $\mathbf{q}_{\boldsymbol{\mu}}^j$ is identical, then in order to solve for a solution of $\mathbf{q}_{\boldsymbol{\mu}}^j$ in system (2.5), we also need to assume that *rank* [**M**] ≥ *H* which implies that K ≥ *H*. If *K* = *H*, and **M** has full rank such that *rank* [**M**] = *H*, we can obtain a unique solution for $\mathbf{q}_{\boldsymbol{\mu}}^j$ which is

$$\mathbf{q}_{\boldsymbol{\mu}}^j = \mathbf{M}^{-1}\mathbf{q}_{\mathbf{z}}^j. \tag{2.6}$$

However, this unique solution of $\mathbf{q}_{\boldsymbol{\mu}}^j$ from system (2.6) imposes no testable restrictions on the collective model because only $\mathbf{q}_{\mathbf{z}}^j$ is observable, while $\mathbf{q}_{\boldsymbol{\mu}}^j$ and $\mathbf{M}^{-1}$ are not. Thus, to be able to derive any testable restrictions, we must have $K > H$ or, in other words, we must have at least as many distribution factors as the number of decision makers in the household.

When $K > H$, we then have an over-identified system. This over-identified system is crucial for us because it allows us to manipulate system (2.5) so that there are $C_{K,H}$ which equals to $\frac{K!}{H!(K-H)!}$ ways to solve for $\mathbf{q}_{\boldsymbol{\mu}}^{j}$, but all solutions must be identical. These manipulations imply restrictions among $\mathbf{q}_{\mathbf{z}}^{j}$ which also involve the unobservable $\mathbf{M}$ matrix. Thus, to solve for $\mathbf{q}_{\boldsymbol{\mu}}^{j}$, I first delete any arbitrary (K-H) rows from $\mathbf{q}_{\mathbf{z}}^{j}$ and $\mathbf{M}$ in system (2.5) to form new $C_{K,H}$ just-identified systems:

$$\mathbf{q}_{\mathbf{z}[\dim H]}^{j} = \mathbf{M}_{[\dim H]}\mathbf{q}_{\boldsymbol{\mu}}^{j} \tag{2.7}$$

where $\mathbf{q}_{\mathbf{z}[\dim H]}^{j}$ is an Hx1 vector of partial derivatives of q^j with respect to the remaining z_k; $\mathbf{M}_{[\mathrm{dimH}]}$ is a square matrix of dimension H of partial derivatives of μ_h with respect to the remaining z_k; where $\mathbf{q}_{\boldsymbol{\mu}}^{j}$ remains the same. Let us further assume that $\mathbf{M}_{[\mathrm{dimH}]}$ has a full column rank H, so it is invertible. Then, we can solve for $\mathbf{q}_{\boldsymbol{\mu}}^{j}$ by

$$\mathbf{q}_{\boldsymbol{\mu}}^{j} = \mathbf{M}_{[\dim H]}^{-1}\mathbf{q}_{\mathbf{z}[\dim H]}^{j}. \tag{2.8}$$

Systems (2.7) and (2.8) show how we have $C_{K,H}$ ways to solve for $\mathbf{q}_{\boldsymbol{\mu}}^{j}$. However, there are some redundancies among these $C_{K,H}$ systems which allow us to eliminate some systems with common constraints. As a result, we need to consider only (K/H) systems if (K/H) is an integer; or otherwise, the closest integer higher than (K/H). Since the expressions for the general case are cumbersome in terms of notations at this point, I use an example to illustrate how systems (2.7) and (2.8) operate so that later on we can easily extend to the case of any number of *K* and *H*.

Let us consider households consisting of three income earners living with or without dependents. Any dependents are assumed to play only a passive role and have no decision-making power. Also assume that the distribution factors are the three earners' exogenous labor incomes. Thus, we have $H = 2$ and $K = 3$ which is the simplest case to test the collective model for households with more than two decision makers. In this case, there are $C_{3,2} = 3$ systems that can solve for $\mathbf{q}_{\boldsymbol{\mu}}^{j}$, but all solutions must be identical. From (2.7), these three systems are

$$\mathbf{q}_{\mathbf{z}[12]}^{j} = \mathbf{M}_{[12]}\mathbf{q}_{\boldsymbol{\mu}}^{j} \tag{2.7.1}$$

$$\mathbf{q}_{\mathbf{z}[13]}^{j} = \mathbf{M}_{[13]}\mathbf{q}_{\boldsymbol{\mu}}^{j} \tag{2.7.2}$$

$$\mathbf{q}_{\mathbf{z}[23]}^{j} = \mathbf{M}_{[23]}\mathbf{q}_{\boldsymbol{\mu}}^{j} \tag{2.7.3}$$

where the superscripts in the brackets represent the remaining k^{th} rows from the original system (2.7).

Then, we can solve for $\mathbf{q}_{\boldsymbol{\mu}}^{j}$ by

$$\mathbf{q}_{\boldsymbol{\mu}}^{j} = \mathbf{M}_{[12]}^{-1}\mathbf{q}_{\mathbf{z}[12]}^{j} \tag{2.8.1}$$

$$\mathbf{q}_{\boldsymbol{\mu}}^{j} = \mathbf{M}_{[13]}^{-1}\mathbf{q}_{\mathbf{z}[13]}^{j} \tag{2.8.2}$$

$$\mathbf{q}_{\boldsymbol{\mu}}^{j} = \mathbf{M}_{[23]}^{-1}\mathbf{q}_{\mathbf{z}[23]}^{j}. \tag{2.8.3}$$

Since we have (K/H) = 1.5, then we need to consider only two out of the three systems (2.8.1), (2.8.2) and (2.8.3). It can easily be shown that once the constraints of the selected two systems are met, the constraints in the remaining system will be automatically satisfied. The criterion for which systems to be selected is straightforward. We need to select the smallest number of systems such that they cover constraints for all K rows in the original $\mathbf{M}$ matrix. With 3 rows to be covered, we can select any of the following 3 pairs of systems; (2.8.1) and (2.8.2); (2.8.1) and (2.8.3); or (2.8.2) and (2.8.3). The choice of pairs will not alter the final result. For example, I select systems (2.8.1) and (2.8.2) to illustrate the main concept of this approach.

From (2.8.1) and (2.8.2), we know that

$$\mathbf{q}_{\boldsymbol{\mu}}^{j} \;=\; \mathbf{M}_{[12]}^{-1}\mathbf{q}_{\mathbf{z}[12]}^{j} \;=\; \mathbf{M}_{[13]}^{-1}\mathbf{q}_{\mathbf{z}[13]}^{j}\,.$$

Then, we can get rid of $\mathbf{q}_{\boldsymbol{\mu}}^{j}$ to obtain

$$\mathbf{q}_{\mathbf{z}[12]}^{j} \;=\; \Omega_{\{[12][13]^{-1}\}}\mathbf{q}_{\mathbf{z}[13]}^{j} \tag{2.9}$$

where $\Omega_{\{[12][13]^{-1}\}} \;=\; \mathbf{M}_{[12]}\mathbf{M}_{[13]}^{-1}$.

It is useful to our analysis to expand system (2.9) to get

$$\begin{bmatrix} q_{z_1}^{j} \\ q_{z_2}^{j} \end{bmatrix} = \begin{bmatrix} \omega_{\{[12][13]^{-1}\}}^{11} & \omega_{\{[12][13]^{-1}\}}^{12} \\ \omega_{\{[12][13]^{-1}\}}^{21} & \omega_{\{[12][13]^{-1}\}}^{22} \end{bmatrix} \begin{bmatrix} q_{z_1}^{j} \\ q_{z_3}^{j} \end{bmatrix}$$

where $\omega_{\{[12][13]^{-1}\}}^{rc}$, r = 1, 2; c = 1, 2 represents the elements corresponding to the r^{th} row and c^{th} in $\Omega_{\{[12][13]^{-1}\}}$.

When fully calculated, system (2.9) becomes

$$\begin{bmatrix} q_{z_1}^{j} \\ q_{z_2}^{j} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ \omega_{\{[12][13]^{-1}\}}^{21} & \omega_{\{[12][13]^{-1}\}}^{22} \end{bmatrix} \begin{bmatrix} q_{z_1}^{j} \\ q_{z_3}^{j} \end{bmatrix}$$

which is equivalent to

$$q_{z_2}^{j} \;=\; \omega_{\{[12][13]^{-1}\}}^{21} q_{z_1}^{j} + \omega_{\{[12][13]^{-1}\}}^{22} q_{z_3}^{j}\,. \tag{2.9.1}$$

Eq (2.9.1) consists of all three influences from distribution factors $q^j_{z_1}, q^j_{z_2}, q^j_{z_3}$ and two unknowns $\omega^{21}_{\{[12][13]^{-1}\}}$ and $\omega^{22}_{\{[12][13]^{-1}\}}$ which are functions of the partial derivatives of $\boldsymbol{\mu}$ with respect to **z**. However, having only one good *j* does not provide us with sufficient information to solve for the two unknowns, so one or more additional goods is required to derive testable restrictions in this case.

One important thing to be noticed here is that the first row of $\Omega_{\{[12][13]^{-1}\}}$ contains only zero and one elements which are constant across all goods. This implies that the first row of $\Omega_{\{[12][13]^{-1}\}}$ does not provide any restriction that can be tested. Thus, the only row that can be used to derive the restrictions is the second row which I will call the "non-zero-and-one" row. The concept of the "non-zero-and-one" row will be crucial in determining the total number of restrictions when we consider more general cases later on in this section.

Next, I will show how many goods are required in order for us to impose testable restrictions on the collective model. Consider the second good, *i*, that the household chooses to consume. From (2.3), we have

$$q^i \;=\; \sum_{h=1}^{H+1} q^i_h = q^i(x, \mathbf{a}, \mu_1(x, \mathbf{a}, \mathbf{z}), \ldots, \mu_H(x, \mathbf{a}, \mathbf{z}))\,.$$

Follow the same procedure earlier to obtain

$$\mathbf{q}^i_{\mathbf{z}[12]} \;=\; \Omega_{\{[12][13]^{-1}\}} \mathbf{q}^i_{\mathbf{z}[13]}\,. \tag{2.10}$$

Then,

$$q^i_{z_2} \;=\; \omega^{21}_{\{[12][13]^{-1}\}} q^i_{z_1} + \omega^{22}_{\{[12][13]^{-1}\}} q^i_{z_3}\,. \tag{2.10.1}$$

From (2.9.1) and (2.10.1), we now have two equations with two unknowns. Then, we can solve for $\omega^{21}_{\{[12][13]^{-1}\}}$ and $\omega^{22}_{\{[12][13]^{-1}\}}$ to get

$$\omega^{21}_{\{[12][13]^{-1}\}} \;=\; f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^i_{z_1}, q^i_{z_2}, q^i_{z_3}) \text{ and}$$

$$\omega^{22}_{\{[12][13]^{-1}\}} \;=\; f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^i_{z_1}, q^i_{z_2}, q^i_{z_3}).$$

However, these results still cannot provide us with any testable restrictions because we can only observe the values of $(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^i_{z_1}, q^i_{z_2}, q^i_{z_3})$ and $f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^i_{z_1}, q^i_{z_2}, q^i_{z_3})$ on the right hand sides, while the values of $\omega^{21}_{\{[12][13]^{-1}\}}$ and $\omega^{22}_{\{[12][13]^{-1}\}}$ on the left hand sides are still unobservable. It means that we need to consider more goods in order to eliminate the unobservable ω terms.

Let consider the third good, l, and follow the same procedure to get

$$\mathbf{q}^l_{\mathbf{z}[12]} \;=\; \Omega_{\{[12][13]^{-1}\}}\mathbf{q}^l_{\mathbf{z}[13]}. \tag{2.11}$$

Then,

$$q^l_{z_2} \;=\; \omega^{21}_{\{[12][13]^{-1}\}} q^l_{z_1} + \omega^{22}_{\{[12][13]^{-1}\}} q^l_{z_3}. \tag{2.11.1}$$

Eqs. (2.9.1), (2.10.1) and (2.11.1) represent a system of three equations that contain all the required information to derive the restrictions with two unobservable ω terms. The testable restrictions can be obtained through multiple steps as follows:

<u>Step 1</u>: From (2.9.1), we can solve for $\omega^{21}_{\{[12][13]^{-1}\}}$ in terms of a base good, j, to obtain

$$\omega^{21}_{\{[12][13]^{-1}\}} \;=\; f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, \omega^{22}_{\{[12][13]^{-1}\}}) \;=\; \frac{q^j_{z_2} - \omega^{22}_{\{[12][13]^{-1}\}} q^j_{z_3}}{q^j_{z_1}}. \tag{2.9.1.1}$$

Step 2: Substitute (2.9.1.1) into (2.10.1) and (2.11.1), then solve for $\omega^{22}_{\{[12][13]^{-1}\}}$ to obtain

$$\omega^{22}_{\{[12][13]^{-1}\}} = f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^i_{z_1}, q^i_{z_2}, q^i_{z_3}) = \frac{q^j_{z_1} q^i_{z_2} - q^i_{z_1} q^j_{z_2}}{q^j_{z_1} q^i_{z_3} - q^i_{z_1} q^j_{z_3}}, \tag{2.10.1.1}$$

$$\omega^{22}_{\{[12][13]^{-1}\}} = f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^l_{z_1}, q^l_{z_2}, q^l_{z_3}) = \frac{q^j_{z_1} q^l_{z_2} - q^l_{z_1} q^j_{z_2}}{q^j_{z_1} q^l_{z_3} - q^l_{z_1} q^j_{z_3}}. \tag{2.11.1.1}$$

Step 3: Setting (2.10.1.1) equals (2.11.1.1) to eliminate the unobservable $\omega^{22}_{\{[12][13]^{-1}\}}$ to obtain a unique testable restriction for the collective model which is

$$\frac{q^j_{z_1} q^i_{z_2} - q^i_{z_1} q^j_{z_2}}{q^j_{z_1} q^i_{z_3} - q^i_{z_1} q^j_{z_3}} = \frac{q^j_{z_1} q^l_{z_2} - q^l_{z_1} q^j_{z_2}}{q^j_{z_1} q^l_{z_3} - q^l_{z_1} q^j_{z_3}}. \tag{2.12}$$

Thus, in the case of H = 2 and K = 3, we need at least three goods to achieve one testable restriction. This finding gives us another requirement for testing the collective model that we need at least as many goods as the decision makers in the household or $N \geq H+1$. Another interesting finding from these steps is that the choice of whether we first choose to solve for either $\omega^{21}_{\{[12][13]^{-1}\}}$ or $\omega^{22}_{\{[12][13]^{-1}\}}$ in step 1 does not affect the number of restrictions to be obtained. It means that after achieving restriction (2.12), we do not need to repeat steps 1, 2 and 3 again to first solve for $\omega^{22}_{\{[12][13]^{-1}\}}$ to derive another restriction that

$$\omega^{21}_{\{[12][13]^{-1}\}} = f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^i_{z_1}, q^i_{z_2}, q^i_{z_3}) = f(q^j_{z_1}, q^j_{z_2}, q^j_{z_3}, q^l_{z_1}, q^l_{z_2}, q^l_{z_3}). \tag{2.13}$$

The reason behind this is straightforward. Even though (2.13) provides us with a legitimate testing restriction, it does not provide any new information that has not already been contained in (2.12). The testing expressions may look different between (2.12) and (2.13), but only one restriction is sufficient to test the collective model. This shows that only one restriction is required for each "non-zero-and-one" row in $\Omega_{\{[12][13]^{-1}\}}$. Therefore, we only need one restriction in this particular example.

Next, let us see how the values of N and K affect the number of restrictions for households with H+1 members in general. If we follow the same procedure above with additional information on extra goods (now $N > 3$) while H and K remain the same at two and three, then we will obtain more than one restriction. The additional restrictions come from the fact that now we have extra information on N which is greater than the minimum requirement of H+1 by ($N - H - 1$) goods. This shows that having additional goods implies additional restrictions. Consequently, we will have extra equations that can solve for $\omega^{22}_{\{[12][13]^{-1}\}}$; as a result, having extra ($N - H - 1$) restrictions to test the collective model. Thus, in case of $N > H+1$, we have a total of ($N - H$) restrictions for each "non-zero-and-one" row in $\Omega_{\{[12][13]^{-1}\}}$.

To determine the number of the "non-zero-and-one" rows for the general case is quite straightforward. It can be determined by the difference between the values of K and H. For example, from (2.7), if we consider the case where $K = 4$ and $H = 2$ and follow the same procedure we would get

$$\mathbf{q}^j_{\boldsymbol{\mu}} = \mathbf{M}^{-1}_{[12]}\mathbf{q}^j_{\mathbf{z}[12]} = \mathbf{M}^{-1}_{[34]}\mathbf{q}^j_{\mathbf{z}[34]}.$$

Thus, we can get rid of $\mathbf{q}^j_{\boldsymbol{\mu}}$ to obtain

$$\mathbf{q}^j_{\mathbf{z}[12]} = \Omega_{\{[12][34]^{-1}\}}\mathbf{q}^j_{\mathbf{z}[34]} \tag{2.14}$$

where $\Omega_{\{[12][34]^{-1}\}} = \mathbf{M}_{[12]}\mathbf{M}^{-1}_{[34]}$.

Expand system (2.14) to get

$$\begin{bmatrix} q_{z_1}^j \\ q_{z_2}^j \end{bmatrix} = \begin{bmatrix} \omega_{\{[12][34]^{-1}\}}^{11} & \omega_{\{[12][34]^{-1}\}}^{12} \\ \omega_{\{[12][34]^{-1}\}}^{21} & \omega_{\{[12][34]^{-1}\}}^{22} \end{bmatrix} \begin{bmatrix} q_{z_3}^j \\ q_{z_4}^j \end{bmatrix}$$

where $\omega_{\{[12][34]^{-1}\}}^{rc}$, r = 1, 2; c = 1, 2 represents the elements corresponding to the r^{th} row and c^{th} column of $\Omega_{\{[12][34]^{-1}\}}$. The main difference between systems (2.14) and (2.9) is that when $\Omega_{\{[12][34]^{-1}\}}$ in (2.14) is fully calculated, it does not contain any "non-zero-and-one" row as in $\Omega_{\{[12][13]^{-1}\}}$ from (2.9). Thus, system (2.14) provides us with 2 constraints:

$$q_{z_1}^j = \omega_{\{[12][34]^{-1}\}}^{11} q_{z_3}^j + \omega_{\{[12][34]^{-1}\}}^{12} q_{z_4}^j \tag{2.14.1}$$

$$q_{z_2}^j = \omega_{\{[12][34]^{-1}\}}^{21} q_{z_3}^j + \omega_{\{[12][34]^{-1}\}}^{22} q_{z_4}^j \ . \tag{2.14.2}$$

As we have seen earlier that when $N = H+1$, each "non-zero-and-one" row corresponds to having one restriction. Then, with $N = H+1$, system (2.14) will provide two restrictions. This additional restriction comes from the fact that as the number of K increases, each of them will impact decision powers within the household. In the case of $N = H+1$, the number of "non-zero-and-one" rows can be easily determined by $K - H$.

Therefore, in general, the total number of restrictions will be equaled to $(N - H)(K - H)$. Even though this approach seems rather complicated, to my knowledge, this is the first approach that allows us to derive the precise testable restrictions to test the collective model of household behaviors with multiple decision makers. The only drawback from this approach is that, due to the flexibilities of this model in general, there is no immediate formula to determine the exact expressions of each testable restriction. The restrictions are different for each possible value of N, K and H.

2.3. The concept of conditional demand systems

The theoretical framework in the previous section shows that the testable restrictions derived from unconditional demand systems can be very complicated and cumbersome, especially when the numbers of N, H and K increase. This section, I will briefly describe an alternative approach which has recently been used in the literature, based on conditional demand systems.

According to Browning and Meghir (1991), conditional demand systems originally were used in demand analysis where the demand for one set of goods (goods of interest) are conditioned on prices of these goods, total expenditures on these goods, and the quantities of another set of goods (conditioning goods). However, in considering the restrictions implied by the collective model, Bourguignon et al. (1995; 2009) extend the original concept of conditional demand systems to define what they call "*z*-conditional demands" in which the demand for one good can be expressed as a function of the demand for another good, total expenditure, preferences and distribution factors. Several studies have applied the concept of *z*-conditional demand systems to examine properties of collective models; in particular, Dauphin and Fortin (2001, hereafter DF), Dauphin et al. (2003), Donni (2006), and Donni and Moreau (2007).

In this chapter, I will consider a particular type of *z*-conditional demand systems used in DF to derive different sets of testable restrictions as alternative ways to test the collective model. To make this a self-contained chapter, I will also outline the theoretical discussion presented by DF. Let us follow DF by first using the demand functions (2.3) obtained in the previous section, so we can rewrite (2.3) as:

$$\tilde{\mathbf{q}}(x, \mathbf{a}, \mathbf{z}) = \hat{\mathbf{q}}(x, \mathbf{a}, \boldsymbol{\mu}(x, \mathbf{a}, \mathbf{z})) \tag{2.15}$$

where $\tilde{\mathbf{q}}(x,\mathbf{a},\mathbf{z})$ and $\hat{\mathbf{q}}(x,\mathbf{a},\boldsymbol{\mu}(x,\mathbf{a},\mathbf{z}))$ are the observable and unobservable *N*x1 vectors of the demands for all *N* goods, respectively. The key issue here is to first find a way to test whether the demands systems can actually be written as $\hat{\mathbf{q}}(x,\mathbf{a},\boldsymbol{\mu}(x,\mathbf{a},\mathbf{z}))$ since this form contains the unobservable welfare weights, $\boldsymbol{\mu}(x,\mathbf{a},\mathbf{z})$.

To make it less cumbersome, let us drop *x* and **a** from all demand functions such that (2.15) becomes

$$\tilde{\mathbf{q}}(\mathbf{z}) \;=\; \hat{\mathbf{q}}(\boldsymbol{\mu}(\mathbf{z})). \tag{2.16}$$

Next, based on a particular type of *z*-conditional demand systems developed by Bourguignon et al. (1995) and generalized by DF, they are able to derive a local test for the collective model. First, they consider partitions $\mathbf{q}=[\mathbf{q}_1',\mathbf{q}_2']'$ of the demand systems and $\mathbf{z}=[\mathbf{z}_1',\mathbf{z}_2']'$ of the distribution factors, with $\mathbf{q}_1$ and $\mathbf{z}_1$ having the same dimension *k*. Given such a partition, (2.16) can be written as:

$$\mathbf{q}_1 \;=\; \tilde{\mathbf{q}}_1(\mathbf{z}_1,\mathbf{z}_2) \;=\; \hat{\mathbf{q}}_1(\boldsymbol{\mu}(\mathbf{z}_1,\mathbf{z}_2)), \tag{2.17}$$

$$\mathbf{q}_2 \;=\; \tilde{\mathbf{q}}_2(\mathbf{z}_1,\mathbf{z}_2) \;=\; \hat{\mathbf{q}}_2(\boldsymbol{\mu}(\mathbf{z}_1,\mathbf{z}_2)). \tag{2.18}$$

Apply Lemma 1 and Theorem 1 from DF and adjust names of variables and equations corresponding to the notation used in this paper, we have

> **Lemma 1.** *Let N ≥ H + 1 and K ≥ H + 1 and consider a* $\mathbf{z}^*\in\Re^K$ *at which* $\tilde{\mathbf{q}}(\mathbf{z})$ *is differentiable. Next, assume that* $D_{z_1}\tilde{\mathbf{q}}_1(\mathbf{z}^*)$ *is non-singular and let* $\mathbf{q}_1{}^*=\tilde{\mathbf{q}}_1(\mathbf{z}_1{}^*,\mathbf{z}_2{}^*)$. *Then, conditional on* $\mathbf{q}_1{}^*$, *there exist a unique and continuously differentiable function* $\tilde{\mathbf{z}}_1(\mathbf{q}_1{}^*,\mathbf{z}_2)$ *that solves that solves (2.17) for* $\mathbf{z}_1$ *on some neighborhood of* $(\mathbf{q}_1{}^*,\mathbf{z}_2{}^*)$ *and such that:*

$$\mathbf{q}_1{}^*=\tilde{\mathbf{q}}_1(\tilde{\mathbf{z}}_1(\mathbf{q}_1{}^*,\mathbf{z}_2),\mathbf{z}_2)=\hat{\mathbf{q}}_1(\boldsymbol{\mu}(\tilde{\mathbf{z}}_1(\mathbf{q}_1{}^*,\mathbf{z}_2),\mathbf{z}_2)). \tag{2.19}$$

Proof. Use the implicit function theorem.

Under the conditions of Lemma 1, one can define the function $\overline{\mathbf{q}}_2 : \Re^K \rightarrow \Re^{N-k}$ by:

$$\overline{\mathbf{q}}_2(\mathbf{q}_1*, \mathbf{z}_2) = \hat{\mathbf{q}}_2(\boldsymbol{\mu}(\tilde{\mathbf{z}}_1(\mathbf{q}_1*, \mathbf{z}_2), \mathbf{z}_2)). \tag{2.20}$$

The right hand side of (2.20) yields a (local) demand sub-system for $\mathbf{q}_2$ conditional on the *k*-vector $\mathbf{q}_1*$.

Theorem 1. *Let the conditions of Lemma 1 hold and suppose that, in addition,* $\boldsymbol{\mu}(\mathbf{z})$ *and* $\hat{\mathbf{q}}(\boldsymbol{\mu}(\mathbf{z}))$ *are differentiable at, respectively,* $\mathbf{z}*$ *and* $\boldsymbol{\mu}(\mathbf{z}*)$. *Then, for k = H the demand system for* $\mathbf{q}$ *satisfies:*

$$D_{z_2}\overline{\mathbf{q}}_2(\mathbf{q}_1*, \mathbf{z}_2*) = \mathbf{0}, \tag{2.21}$$

where $\mathbf{0}$ is a null matrix of dimension $(N-H)\times(K-H)$.

Proof. See p. 214 in DF.

Eq. (2.21) shows that once household demands for the $N-H$ goods, $\overline{\mathbf{q}}_2(\mathbf{q}_1*, \mathbf{z}_2*)$, are conditioned on as many goods as there are the welfare weights (*H* in this case) in the household maximization problem (2.1), the adjustment in $\mathbf{z}_1$ will compensate for any changes in $\mathbf{z}_2$ as to keep $\mathbf{q}_1$ constant in a way that will leave $\boldsymbol{\mu}(\mathbf{z})$ unchanged. Moreover, if $\boldsymbol{\mu}(\mathbf{z})$ stays constant when $\mathbf{z}_2$ changes, then $\mathbf{q}_2$ must also stay constant, and therefore $D_{z_2}\overline{\mathbf{q}}_2(\mathbf{q}_1*, \mathbf{z}_2*) = \mathbf{0}$. Bourguignon et al. (2009) also gives an intuitive explanation that is, for given values of *x* and *a*, whenever distribution factors $(\mathbf{z}_1, \mathbf{z}_2)$ contain some information that is relevant for intra-household allocation, this information is fully summarized by the values of $\mathbf{q}_1$. Once we condition on $\mathbf{q}_1$, $\mathbf{z}_2$ becomes irrelevant.

As suggested by some of the earlier studies (Dauphin and Fortin 2001; Dauphin et al. 2003; Bourguignon et al. 2009), there are both advantages and disadvantages to using the approach of *z*-conditional demand systems to test collective rationality. The key advantage is that, instead of testing for cross-equation restrictions like in the unconditional demand systems which is rather complicated and cumbersome, this approach is likely to be more powerful because testing on exclusion restrictions are more robust than testing restrictions on parameters across equations. On the other hand, one drawback of using this approach is that the estimation of the conditional sub-system may introduce an endogeneity problem since $\mathbf{q}_1$ variables are endogenous. However, we can use instrumental variable technique to solve this problem by using the excluded exogenous variables in $\mathbf{z}_1$ which has the same dimension as $\mathbf{q}_1$, and the most common choices are individual exogenous incomes.

Another drawback from this approach as noted by DF is that when $N = H + 1$, one has $\overline{\mathbf{q}}_2(\mathbf{q}_1*, \mathbf{z}_2*) = x - \mathbf{e}'\mathbf{q}_1*$ from the adding-up restriction. Thus, (2.21) is always satisfied in this case. This requires additional assumption that we must have $N > H + 1$ in order to derive any testable restrictions for the collective model. However, this should not create any major problem for the analysis for two possible reasons as long as we have $N \geq H + 1$ and $K \geq H + 1$. First, household survey data often contain a greater number of consumption categories than the number of household members, so $N > H + 1$ is usually satisfied. The second reason may be that some household surveys may observe the data for only $N^o (\leq N)$ consumption categories such that the adding-up restriction will not always be satisfied.

2.4. Data

As mentioned in the introduction, extended families are very common for the Thai family system, which is somewhat different from the norm of the married couple families in most western countries. This is because, through the hierarchical structure in Thailand, one of the key responsibilities placed on children is to take care of their parents when they are old. Thus, for this particular reason, many Thai households often consist of members of two or more generations living together, while the elderly are awarded the highest status such that they can give advice and consultation on household decisions (Limanonda 1995).

Not only can the elders give advice to household members, but children can also give some thoughts to the elders in certain circumstances. For example, older children who earn incomes will have decision-making powers and may have their own thoughts about how resources should be allocated within the household. Having many income earners in the household will make it more difficult for all members to reach an agreement. Thus, individual incomes can be considered our distribution factors that affect the decision-making power through the welfare weights, $\boldsymbol{\mu}(x, \mathbf{a}, \mathbf{z})$.

The data comes from the same Socio-Economic Survey (SES) conducted by the National Statistical Office of Thailand (NSO) in year 2006 used in chapter one, but with different types of sample. The reader is referred to the data section in chapter one to see how the data are collected. Initially, I planned to consider the case where households have four income earners (two couples from two different generations) to see how this particular situation impacts household consumption choices. It turns out, however, that considering only such households lead to extremely small of a sample size (only six households).

Then, for easier demonstration of the model presented in the previous section, I choose to consider the case where there are three decision makers in the household; with two out of three decision makers are married couples. Since we are considering households with three decision makers, the number of female and male decision makers may be a determinant in the intrahousehold allocation process. This is because the introduction of the third decision maker in the household may shift the balance of the decision power between the married couple to favor the dominant gender of the household. Thus, in addition to individual incomes, I will consider a major gender of household decision makers as additional distribution factor to test the collective model in the next section.

Thus, the sample is limited only to households consisting of three earners (two are married couples); each of them is wage and salary earner who work full-time for a minimum of 35 hours per week outside their home. Moreover, the third decision maker is limited to be either 1) a child of the married couples or 2) a parent of one of the married couples. This results in a total sample size of 443 households. Table 10 provides the main overall descriptive statistics of the sample.

2.5. Empirical model of household expenditures and results

For implementation, I continue to estimate the Quadratic Almost Ideal Demand System (QUAIDS). Without price variations, the QUAIDS model takes the following form of expenditure share equation system:

$$w = \gamma + \beta_E \ln E + \beta_{EE} (\ln E)^2 + \sum_{g=1}^{G} \beta_g a_g + \sum_{k=1}^{K} \beta_k z_k + v \qquad (2.22)$$

where w represents shares of consumption expenditure on each good, E represents total household consumption expenditure, a represents g preference factors, z represents k distribution factors, and where v is a residual term. Notice again that parameters in Equation (2.22) vary over goods whereas variables and the disturbances vary over goods and across households.

Since the shares of consumption expenditure sum up to one, I choose to omit the health category from the systems of equations to accommodate the adding up restriction of the QUAIDS. Table 11 provides the SURE estimates from the system of equations corresponding to the Engel curve (2.22) for 11 consumption categories for the full sample size of 443 households.

The results show that the data fit a little better for seven categories in the case of three decision makers compared to the case where spouses are the only decision makers in the household. However, there are relatively few significant coefficients in the case of households with three decision makers. The coefficients on most household characteristics have similar signs to those in the case of two decision makers (results from chapter one). The coefficients on the third member's characteristics and income are insignificant in most categories. This implies that having additional decision maker does not necessary alter household consumption behaviors. However, the coefficient on major gender provides us with an interesting result. When the third member is male, households significantly spend lower share of consumption on cosmetic, while spend higher share on alcohol and tobacco products. This supports a common claim that cosmetics can be considered as female, while alcohol and tobacco as male products.

Before testing whether households with three decision makers behave efficiently, let us first test whether they behave according to the unitary model since we did not consider households with three decision makers in chapter one. According to Bourguignon et al. (2009)

mention earlier, the existence of distribution factors is inconsistent with the unitary model. Thus, testing the unitary model is the same as testing that $\beta_k = 0,$ for $k = 1,...,K$, that is all coefficients on individual incomes and major gender are zero. Since we estimate the system of 11 consumption categories in this case, this provides us with a total of 44 restrictions to test for the unitary model. The chi-square value of 85.66 rejects income pooling, hence the unitary model, at 1% level of significance.

Again, there is a reason for us to suspect that total consumption expenditure may be endogenous with respect to shares of household consumption expenditure, especially for infrequent purchased categories. When testing for exogeneity of log total expenditure and its square in each category, I find that it is rejected for only two categories that are transportation and communication, and food eaten at home. Nevertheless, I also perform the 3SLS using log total income, log total income square, monthly welfare benefits received from employers, and all explanatory variables to instrument for log of total expenditure and its square. The minimum eigenvalue statistic of 14.00 rejects the hypothesis of weak instruments at 5% level of significance. Moreover, the overidentifying restriction is rejected for only alcohol and tobacco category. This provides us with at least some confidence that the instruments are valid. Table 12 provides the 3SLS estimates corresponding to the Engel curve (2.22) for 11 consumption categories for the full sample size of 443 households.

In general, the 3SLS estimates show some variation in the significance levels of the overall coefficients compared to those reported in Table 11. However, the signs of most coefficients are very similar between the two methods of estimation. Thus, in the comparative statics perspective, there is not much of the difference whether or not we instrument for total consumption expenditure and its square terms. Moreover, a chi-square value of 62.84 also rejects income pooling at the 5% level of significance. Thus, the results from both SURE and 3SLS clearly reject the unitary model for three wage-earner households in Thailand.

Now, let us derive the testable restrictions on the collective rationality by first using the share of housing expenditure as a base good. Following the steps described in section 2.2, testing the Pareto efficient hypothesis for households with three decision makers, four distribution factors and 11 consumption categories provides us with a set of $(N-H)(K-H)=9\times 2=18$ restrictions.[10] We obtain a chi-square value of 4.51 which cannot reject the Pareto efficiency at any significant level. This implies that the three-decision-maker households in Thailand do behave efficiently which is consistent with the collective model. In addition, since the choice of choosing the base good should not alter the final result, I also estimate 10 more sets of restrictions where each set uses different base goods. Table 13 provides the chi-square values for all sets of testable restrictions using different base goods.

The results in Table 13 show that there is not a single case in which we can reject Pareto efficiency. These findings are important because they demonstrate that the approach developed in this chapter is not sensitive or limited to some particular choices of the base good. Thus, using the unconditional demand systems gives us a robust way to test for the validity of the collective model.

Next, I continue to test the collective rationality using the *z*-conditional demand systems used in DF. In order to apply Theorem 1 in DF for the case of three decision makers, the demand systems must be conditioned on two consumption goods which is equal to the number of the

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[10] I use $N=11$ because if all restrictions are satisfied for 11 goods, by adding up, the restriction for the 12th good is also satisfied.

welfare weights, $\boldsymbol{\mu}(x, \mathbf{a}, \mathbf{z})$. Moreover, we also have to select 2 distribution factors such that $\mathbf{z}_1$ has the same dimension as $\mathbf{q}_1$.

Since the systems of equations contain a total of 11 goods, the *z*-conditional demand systems would consist of nine equations, and each equation is conditioned on two conditioning goods. Again, the choice of the two conditioning goods is arbitrary and it should not affect the final result. Thus, we have $C_{11,2}$ = 55 different *z*-conditional demand systems that can test Pareto efficiency. In addition, we also have $C_{4,2}$ = 6 ways to choose the two corresponding distribution factors in each of the 55 *z*-conditional demand systems. Therefore, for a particular case considered in this chapter, we have a total of 330 possible ways to test the collective model, each possibility contains 18 restrictions, and all possibilities should generate the same result.

Under the maintained assumption that $D_{z_1}\tilde{\mathbf{q}}_1(\mathbf{z}^*)$ is non-singular in every possibility, we can directly apply Theorem 1 in DF. The results show that only three out of 330 possibilities can reject the Pareto efficiency at 5% significance while other 327 possibilities cannot.[11] However, none of these three possibilities can pass the non-singularity test of $D_{z_1}\tilde{\mathbf{q}}_1(\mathbf{z}^*)$; as a result, Theorem 1 in DF is not applicable for these three possibilities. Thus, we can say that using the available data, there is not a single possibility that can reject the Pareto efficiency hypothesis.

Therefore, using the *z*-conditional demand systems provide the same conclusion that the three-decision-maker households in Thailand do behave efficiently which is consistent with the results obtained when using the unconditional demand systems. However, the results in this chapter show that even though the *z*-conditional demand approach may be more powerful and

[11] The results are available upon request from the author.

more robust, it also generates many more testing possibilities than the unconditional demand approach. This may be considered as another disadvantage of using the *z*-conditional demand approach. Since each approach has its own strengths and weaknesses, the choice of whether it is best to use the unconditional demand or *z*-conditional demand systems cannot yet be resolved in general.

2.6. Conclusions

Up to now, there are a small number of studies that have proper consumption expenditure data to empirically test the validity of the collective model (Bourguignon et al. 1993; Thomas and Chen 1994). However, these previous studies only test the Pareto efficiency hypothesis for households consisting of only two decision makers. None of them has ever tested Pareto efficiency in the case of households with multiple decision makers.

This chapter generalizes and tests whether larger households with more than two decision makers behave efficiently by applying the concept of distribution factors. Distribution factors are variables that only affect the household decision process, but not on individual preferences or the household budget constraint. This chapter extends the model used in chapter one to derive the testable restrictions on the collective model for households with any number of decision makers using the unconditional demand systems approach. This approach can also apply to broader cases where there are more distribution factors than the number of decision makers in the household.

Moreover, I also consider a particular type of *z*-conditional demand systems used in Dauphin and Fortin (2001) to derive different sets of testable restrictions as alternative ways to test the collective model. The results show that both unconditional and *z*-conditional demand systems provide similar outcomes that the three-decision-maker households in Thailand behave efficiently, which is consistent with the collective framework.

CHAPTER THREE: COLLECTIVE MODEL AND WITHIN-HOUSEHOLD CONSUMPTION INEQUALITY

3.1. Introduction

A major application of demand analysis for applied welfare economics is the measurement of consumption inequality between households using household equivalence scales. These scales may be used to determine how much income a household with a given composition would need to attain the same welfare level as a reference household. Equivalence scales are based on the unitary assumption that consumption decisions are made to maximize a single household welfare function. Results of chapters one and two, however, suggest that consumption decisions in Thai households are not consistent with the unitary model, but are consistent with the collective model. This chapter estimates indifference scales, alternatives to equivalence scales that are based on the collective model and that measure consumption inequality between individuals rather than between households. Using indifference scales, we may be able to examine welfare effects of public policy on inequality in society, such as effects of policies regarding poverty reduction.

In Thailand, poverty reduction has played a significant role in country's development goals. These goals include improving the well-being of disadvantaged families, sharing the benefits of growth across communities, and connecting remote regions within the country and with the rest of the world. Over the past decades, commitment to poverty reduction by policy makers, businesses, and civil society has coincided with a remarkable record of poverty reduction. For example, the national poverty headcount, defined as the share of people living in households with income below the poverty line, fell from 32.6 percent in 1988 to 11.4 percent in

1996, then rose to 14.2 percent up to 2000 due to the consequences of the Asian crisis before it declined with the economic recovery and dropped below 10 percent for the first time (Jitsuchon and Richter 2006). Despite this record, there are some concerns about the effectiveness of economic policies in supporting continued growth in household income and providing communities with access to basic services.

In 2001, Thai government adopted a number of poverty reduction policies such as the Village Fund, asset capitalization, and the BAHT 30 (about $1) health care system. However, many of the policies have limited coverage or significant benefit leakage to the nonpoor because they cover large populations. Improved targeting through better criteria for the allocation of resources is essential if the number of the poor is to be reduced. For example, the Village Fund was launched in 2001 as a revolving fund of BAHT 1 million that was to be distributed to about 70,000 villages nationwide over a three-year period. A key characteristic of the program is that it covers every single village in the country, regardless of whether the village is poor or nonpoor. In fact, the bulk of the beneficiaries of the program are nonpoor households. The poverty impact of the Village Fund would be increased if the same resources were allocated in a more targeted fashion toward poor villages or if loans were provided at more favorable terms to low-income households or individuals within the households (Jitsuchon and Richter 2006).

Although the success of the collective approach to household behavior has been recognized and there is growing interest in making inequality or welfare comparisons between individuals rather than households, survey data are generally collected at the household level. Welfare or inequality statements are usually measured at this level. For example, previous studies in the consumption literature use equivalence scales to measure consumption inequality.

Equivalence scales measure individual inequality rather than household inequality only if there is no within-household inequality. The interpretation of standard equivalence scales as measures of individual inequality implies a very restricted model of intrahousehold allocation by assuming that consumption is divided equally among household members regardless of individual preferences, sources of incomes, or decision-making powers. Findings from the previous two chapters, however, suggest that individual preferences, sources of incomes, and decision making powers influence consumption decisions. Then, ignoring the consumption inequality within households may give misleading estimates of the individual inequality.

This chapter examines the use of household consumption data without price variation to recover information about individual household members and consumption inequality. The chapter focuses on single and married women, using collective household models developed in Lewel and Pendakur (2008), hereafter LP. The LP model is based on the structural model proposed by Browning et al. (2004), hereafter BCL. BCL assumed that households consumed a vector of goods ranging from purely private to very sharable, and showed how to recover individual resource shares and indifference scales via demand system estimation. However, the model used in BCL is highly nonlinear in prices, expenditures and other characteristics and is very difficult to estimate, both computationally and in terms of data requirements. On the other hand, the model used in LP provides a way to estimate the parameters of interest and obtain identification without price variation, so that the demand system reduces to a system of Engel curves.

This chapter is organized as follows: Section 3.2 discusses the model used to estimate the resource shares and indifference scales. Section 3.3 outlines systems of Engel curves estimated in this chapter. Section 3.4 describes sample data and presents results. Finally, the conclusions are provided in Section 3.5.

3.2. The model

Let us begin by considering the LP model of household demands where each household member is denoted by $j = 1,..., J$. Let x denote log total household expenditure and $\mathbf{p} = [p^1,..., p^K]'$ denote the K-vector of log market prices. The budget share of individual j on good k is denoted by $w_j^k(\mathbf{p}, x)$, that is, if individual j were living alone, he/she would spend the fraction $w_j^k(\mathbf{p}, x)$ of total expenditure exp(x) on good k. Assume that the household has a type of economies of scale from sharing consumption according to Barten (1964), that is, there exists a K-vector of constant $\boldsymbol{\alpha} = [\alpha^1,..., \alpha^K]'$, called log Barten scales, such that the total log quantity of good k consumed by the members of the household equals the log quantity of the good purchased by the household minus α^k. Thus, α^k can be interpreted as the degree of publicness or the economy of scale for good k within the household; a purely private good k would have $\alpha^k = 0$, while a good that is shared has $\alpha^k < 0$.

Let $w_j^k(\mathbf{p}, x, \boldsymbol{\alpha})$ denote the budget share for good k of a household which is comprised of individuals $j = 1,..., J$, and has log Barten scale parameters, $\boldsymbol{\alpha}$. Individuals living alone are assumed to have no economies of scale to consumption, and so have log Barten scale parameters equal to zero. Thus, for each good k and individual j, $w_j^k(\mathbf{p}, x)$ denotes the budget share demand function for a household consisting just of individual j living alone.

With some technical restrictions, BCL proves that if the household behaves Pareto efficiently and shares consumption within the household according to the Barten technology above, then the household budget share for good *k* is given by

$$w^k(\mathbf{p}, x, \boldsymbol{\alpha}) = \sum_j \eta_j(\mathbf{p}, x, \boldsymbol{\alpha}) w_j^k(\boldsymbol{\alpha} + \mathbf{p}, x + \ln \eta_j(\mathbf{p}, x, \boldsymbol{\alpha})) \tag{3.1}$$

where $\eta_j(\mathbf{p}, x, \boldsymbol{\alpha})$ is the resource share of individual *j* in the household and $\sum_j \eta_j(\mathbf{p}, x, \boldsymbol{\alpha}) = 1$. Equation (3.1) illustrates how efficiency can be obtained by having each household member behave as if maximizing his/her own utility functions given a fraction η_j of the household total expenditure, exp(*x*), and facing log shadow prices $\boldsymbol{\alpha} + \mathbf{p}$ which reflect the economies of scale from sharing. The two elements of household demand functions of most interest here are resource shares and indifference curves. BCL shows that resource shares can be nonparametrically identified by combining data on multiple person households with data on individuals living alone. Since we have already defined resource shares, we now define indifference scales.

Let $V_j(\mathbf{p}, x)$ denote the indirect utility of individual *j* and suppose that the household has Barten scales $\boldsymbol{\alpha}$ and individual *j* in the household has resource share $\eta_j(\mathbf{p}, x, \boldsymbol{\alpha})$. BCL defines an indifference scale $I_j(\mathbf{p}, x, \boldsymbol{\alpha})$ as the solution to

$$V_j(\boldsymbol{\alpha} + \mathbf{p}, \ln \eta_j(\mathbf{p}, x, \boldsymbol{\alpha}) + x) = V_j(\mathbf{p}, \ln I_j(\mathbf{p}, x, \boldsymbol{\alpha}) + x). \tag{3.2}$$

Equation (3.2) shows that if we multiply the total household expenditure by the indifference scale $I_j(\mathbf{p}, x, \boldsymbol{\alpha})$, and give that amount of income to individual *j* living alone (facing log market price $\mathbf{p}$), then individual *j* would be able to purchase a bundle of goods that lies on the same indifference curve as if he/she were to consume as a member of the household.

Indifference scales differ from the standard adult equivalence scales in that equivalence scales equate the utility of an individual to the utility of a household, and then compare the utility of one household to the utility of another household. Equivalence scales thus face the fundamental problems associated with interpersonal comparisons of utility. On the other hand, indifference scales depend only on the indifference curves of individual *j* in two different situations, i.e., living alone facing market prices, versus living in a household consuming his/her share of the household's resources and facing shadow prices. As a result, indifference scales can potentially be identified just from revealed preference data. One assumption needs to be imposed here, that is, individual *j*'s indifference curves over the goods themselves remain the same whether he/she living as a single or as a member of a household. Changes in consumption behaviors between living alone or with other persons are attributed merely to sharing of consumptions and resources rather than changes in preferences.

Next, let us define the Independence of Base (IB) assumption to represent the scale economies. For each individual *j* living in a household, assume that there exists a scalar-valued function $D_j(\mathbf{p}, \boldsymbol{\alpha})$ that satisfies the condition

$$V_j(\boldsymbol{\alpha} + \mathbf{p}, x) = V_j(\mathbf{p}, x - \ln D_j(\mathbf{p}, \boldsymbol{\alpha})) \tag{3.3}$$

Equation (3.3) is a joint restriction on the behavior of the individual and the household, because it involves the individual's utility function V_j and the household's scale economy parameters $\boldsymbol{\alpha}$. The function $D_j(\mathbf{p}, \boldsymbol{\alpha})$ measures the cost savings experienced by individual *j* resulting from scale economies of living in the household. These scale economies are assumed to be independent of the base expenditure (or utility) level. This assumption is similar to the IB restriction in the equivalence scale literature (Lewbel 1989; Blundell and Lewbel 1991; Blundell et al. 1998).

When applying Roy's identity to Eq. (3.3), individual *j*'s budget share functions on good *k* can be written as

$$w_j^k(\boldsymbol{\alpha}+\mathbf{p},x) = d_j^k(\mathbf{p},\boldsymbol{\alpha}) + w_j^k(\mathbf{p}, x - \ln D_j(\mathbf{p},\boldsymbol{\alpha})) \tag{3.4}$$

where

$$d_j^k(\mathbf{p},\boldsymbol{\alpha}) = \frac{\partial \ln D_j(\mathbf{p},\boldsymbol{\alpha})}{\partial p^k} \tag{3.5}$$

is the elasticity of D_j with respect to the k^{th} price. The consequence of the IB assumption in the present context is that the demands of individual *j* when living alone differ from her demands when living in a household only in that they are translated over log expenditure *x* by $\ln D_j(\mathbf{p},\boldsymbol{\alpha})$ and over each w_j^k by $d_j^k(\mathbf{p},\boldsymbol{\alpha})$.

Assume that resource shares η_j do not depend on *x*, and so are given by $\eta_j(\mathbf{p},\boldsymbol{\alpha}) > 0$. By substituting Eq. (3.4) into (3.1), the household budget share demand functions can be written as

$$w^k(\mathbf{p},x,\boldsymbol{\alpha}) = \sum_j \eta_j(\mathbf{p},\boldsymbol{\alpha})[d_j^k(\mathbf{p},\boldsymbol{\alpha}) + w_j^k(\mathbf{p}, x - \ln I_j(\mathbf{p},\boldsymbol{\alpha}))] \tag{3.6}$$

where

$$I_j(\mathbf{p},\boldsymbol{\alpha}) = \frac{D_j(\mathbf{p},\boldsymbol{\alpha})}{\eta_j(\mathbf{p},\boldsymbol{\alpha})} \tag{3.7}$$

is person j's indifference scale (deflator of total expenditure x) which combines the effect of cost savings D_j and resource shares η_j of individual j when living in the household. Eq. (3.6) shows that household budget share equations are a simple function of individual budget share equations; in particular, they are weighted average of individual budget shares translated both in budget shares (weighted by scale economy price elasticities) and log expenditure (weighted by individual indifference scales). Eq. (3.7) shows that individual j's indifference scale is smaller when she receives a larger share of household resources η_j or experiences smaller cost savings from sharing consumption.

We now suppose that data are only observed in one price regime, $\mathbf{p} = \mathbf{p_0}$, as typically occurred when considering cross-sectional data. Both $\mathbf{p_0}$ and $\boldsymbol{\alpha}$ are vectors of constants and can now be taken out of Eq. (3.6). We can then rewrite Eq. (3.6) in Engel curve form as

$$w^k(x) = \sum_j \eta_j [d_j^k + w_j^k(x - \ln I_j)] \tag{3.8}$$

where $w^k(x)$ and $w_j^k(x)$ are the household's and individual j's Engle curves for good k, respectively, and where the resource shares η_j and indifference scales I_j are now constants for each individual j. Moreover, in addition to the fact that $\sum_j \eta_j = 1$, we also need to assume that $\eta_j > 0$ for each household member j, so each household member j can be considered as a decision maker in the household.

Since we have assumed that individual's preferences over goods are the same whether living alone or in a household, observing the expenditure of households and of individuals on each good k in this one price regime allows the Engel curve functions $w^k(x)$ and $w_j^k(x)$ to be identified for each good *k*. However, we need to investigate whether the resource shares η_j and indifference scales I_j can be identified from these Engel curves. Using Theorem 1 in LP, it can be shown that η_j and I_j are nonparametrically identified, as long as some of the goods have budget shares that are nonlinear and are sufficiently different across individuals. Specifically, Theorem 1 says that in a household with *J* people, the resource shares and indifference scales are identified if there are *J* goods having nonlinear Engel curves that differ both across people and across goods. Also note that Theorem 1 is sufficient but not necessary for identification. One may also obtain identification under weaker conditions by the presence of assignable goods, or by functional form restrictions.

3.3. Empirical implementation

For implementation, I follow LP by considering the households consisting of married couples, so $J = 2$. I index the members of the household by $j = f$ for female and $j = m$ for male. Since resource shares η_j sum to one, I define a single share function $\eta = \eta_f$ with $1 - \eta = \eta_m$. Moreover, to exploit data from a survey of many people, I also specify how $w_j^k(x), I_j, \eta, D_j$ and d_j^k vary by observable characteristics such as age and education.

Next, I introduce a vector of demographic characteristics for each individual, $\mathbf{z}_j$, and a vector of distribution factors, $\mathbf{z}_h$. Distribution factors as described in previous two chapters are variables that affect the decision making process but do not directly affect preferences. In the present context, distribution factors are variables that affect resource shares but not the demand functions of individual household members. Thus, $\mathbf{z}_j$ can enter the budget share functions of the relevant singles, $w_j^k(x, \mathbf{z}_j)$ and the scale economies functions and elasticities of the singles $D_j(\mathbf{z}_j)$ and $d_j^k(\mathbf{z}_j)$. Both $\mathbf{z}_h$ and the individual characteristics $\mathbf{z}_f$ and $\mathbf{z}_m$ enter the resource share function $\eta(\mathbf{z}_h, \mathbf{z}_f, \mathbf{z}_m)$, and since the indifference scale is equal to the scale economies divided by the resource share, these arguments also enter the indifference scale $I_j(\mathbf{z}_h, \mathbf{z}_f, \mathbf{z}_m)$.

Let $\mathbf{z} = (\mathbf{z}_h, \mathbf{z}_f, \mathbf{z}_m)$ denote the set of distribution factors and all demographic characteristics, so we can write the resource share and indifference scale functions as $\eta(\mathbf{z})$ and $I_j(\mathbf{z})$. Adding ε error terms for each good $k = 1, ..., K-1$, the model of estimation for single individuals can be written as

$$w_f^k = w_f^k(x, \mathbf{z}_f) + \varepsilon_f^k \tag{3.9}$$

$$w_m^k = w_m^k(x, \mathbf{z}_m) + \varepsilon_m^k \tag{3.10}$$

and for couples as

$$\begin{aligned} w^k &= \eta(\mathbf{z})[w_f^k[x - \ln I_f(\mathbf{z}), \mathbf{z}_f] + d_f^k(\mathbf{z}_f)] \\ &\quad + [1-\eta(\mathbf{z})][w_m^k[x - \ln I_m(\mathbf{z}), \mathbf{z}_m] + d_m^k(\mathbf{z}_m)] + \varepsilon^k \end{aligned} \tag{3.11}$$

where $w_j^k, j = f, m$ is individual *j*'s actual budget share and $w_j^k(x, \mathbf{z}_j), j = f, m$ is the Engel curve function for these shares. Notice that the equation for the K^{th} good in each household type (*f*, *m* and couples) does not need to be estimated, because its parameters can be determined by budget shares summing to one for each household.

Although the parameters of interest, $\eta(\mathbf{z})$ and $I_j(\mathbf{z})$, can be nonparametrically identified from Engel curve data according to Theorem 1 in LP, I will flexibly parameterize the model for empirical tractability. For parameterization, let us continue to estimate the budget share Engel curve models using the Quadratic Almost Ideal Demand System (QUAIDS) which was found to provide a good fit for Engle curves (Banks et al. 1997). Without price variation, the QUAIDS models for single females are given by

$$w_f^k(x, \mathbf{z}_f) = a_f^{k0} + \mathbf{a}_f^{k'}\mathbf{z}_f + (x - \mathbf{e}_f'\mathbf{z}_f)b_f^k + (x - \mathbf{e}_f'\mathbf{z}_f)^2 c_f^k \tag{3.12}$$

and for single males by

$$w_m^k(x, \mathbf{z}_m) = a_m^{k0} + \mathbf{a}_m^{k'}\mathbf{z}_m + (x - \mathbf{e}_m'\mathbf{z}_m)b_m^k + (x - \mathbf{e}_m'\mathbf{z}_m)^2 c_m^k \tag{3.13}$$

for each good $k = 1,\dots,K$, where $\mathbf{z}_f$ and $\mathbf{z}_m$ are vectors of female's and male's demographic characteristics including ages and highest level of education. I also normalize $\mathbf{z}_f$ and $\mathbf{z}_m$ to zero for a reference set of characteristics, which in this chapter are an individual aged 35 with Junior High School as their highest level of education.

Substitute Eqs. (3.12) and (3.13) into (3.11) then gives the budget share Engel curve models for couples as

$$\begin{aligned} w^k &= \eta(\mathbf{z})[a_f^{k0} + \mathbf{a}_f^{k'}\mathbf{z}_f + (x - \ln I_f(\mathbf{z}) - \mathbf{e}_f'\mathbf{z}_f)b_f^k \\ &\quad + (x - \ln I_f(\mathbf{z}) - \mathbf{e}_f'\mathbf{z}_f)^2 c_f^k + d_f^k(\mathbf{z}_f)] \\ &\quad + [1 - \eta(\mathbf{z})][a_m^{k0} + \mathbf{a}_m^{k'}\mathbf{z}_m + (x - \ln I_m(\mathbf{z}) - \mathbf{e}_m'\mathbf{z}_m)b_m^k \\ &\quad + (x - \ln I_m(\mathbf{z}) - \mathbf{e}_m'\mathbf{z}_m)^2 c_m^k + d_m^k(\mathbf{z}_m)] + \varepsilon^k. \end{aligned} \tag{3.14}$$

To estimate the models, I also need to parameterize $D_j(\mathbf{z}_j), d_j^k(\mathbf{z}_j)$ and $\eta(\mathbf{z})$. The indifference scale is given by $\ln I_j(\mathbf{z}) = \ln D_j(\mathbf{z}_j) - \ln \eta_j(\mathbf{z})$. Following LP, I parameterize $D_f(\mathbf{z}_f)$ and $D_m(\mathbf{z}_m)$ as

$$\ln D_f(\mathbf{z}_f) = d_{0f} + \mathbf{d}_f'\mathbf{z}_f, \tag{3.15}$$

$$\ln D_m(\mathbf{z}_m) = d_{0m} + \mathbf{d}_m'\mathbf{z}_m \tag{3.16}$$

and for each $k = 1,..., K$, the price elasticities of the IB scales are parameterized as

$$d_f^k(\mathbf{z}_f) = \delta_{0f}^k + \boldsymbol{\delta}_f^{k'}\mathbf{z}_f, \tag{3.17}$$

$$d_m^k(\mathbf{z}_m) = \delta_{0m}^k + \boldsymbol{\delta}_m^{k'}\mathbf{z}_m. \tag{3.18}$$

Moreover, the resource share function $\eta(\mathbf{z})$ can be parameterized by

$$\eta(\mathbf{z}) = \mathbf{r}'\mathbf{z} = r_0 + \mathbf{r}_h'\mathbf{z}_h + \mathbf{r}_f'\mathbf{z}_f + \mathbf{r}_m'\mathbf{z}_m \tag{3.19}$$

where I take the distribution factor $\mathbf{z}_h$ to be the relative wage of the wife versus the husband as suggested by Browning and Chiappori (1998).

Using Eqs. (3.15) to (3.19), I can write the functional forms for indifference scales $I_f(\mathbf{z})$ and $I_m(\mathbf{z})$ as

$$\ln I_f(\mathbf{z}) = d_{0f} + \mathbf{d}_f'\mathbf{z}_f - \ln(\mathbf{r}'\mathbf{z}) \tag{3.20}$$

$$\ln I_m(\mathbf{z}) = d_{0m} + \mathbf{d}_m'\mathbf{z}_m - \ln(1-\mathbf{r}'\mathbf{z}). \tag{3.21}$$

The model I actually estimate is then obtained by substituting Eq. (3.12) into (3.9) and Eq. (3.13) into (3.10) for singles, and substituting Eqs. (3.17) to (3.21) into Eq. (3.14) for couples, for each $k = 1,..., K-1$ good. We then have a system of $K-1$ equations for each household type. To estimate the functions of interest $\eta(\mathbf{z})$ and $I_j(\mathbf{z})$ requires a two-step process. First, I separately estimate each system of $K-1$ equations for the singles using NLSUR method to obtain $a_j^{k0}, \mathbf{a}_j^{k'}, \mathbf{e}'_j, b_j^k, c_j^k$ for $j = f, m$. Then, I substitute these single parameters into the couple's budget share system (3.14) for each $k = 1,..., K-1$ good, and estimate a system of equations for couples by NLSUR using only just couples data. It is crucial for us to first estimate the systems of equations for singles because, without information on singles, the parameters of interest from the couple's model by itself are not all identified.

According to Theorem 1 in LP, the couple's model above is identified as long as the $2 \times K$ matrices consisting of rows $[b_f^k, b_m^k]$ and $[c_f^k, c_m^k]$ each have rank two and $\eta(\mathbf{z})$ is not equal to zero or one. However, the precision of estimation is likely to be improved by the presence of an assignable good. A good is considered assignable if it is consumed exclusively by only one individual in the collective household. Unfortunately, there are no records of any assignable good in our sample data from Thailand. I try to estimate the models by assuming that cosmetics can be considered as an assignable good for female, while alcohol and tobacco as an assignable good for male. However, the survey data show that approximately 13% of single males report positive expenditures on cosmetics, while 9% of single females report positive expenditures alcohol and tobacco. Since these numbers are relatively large, I choose not include any assignable good to the model.

3.4. Data and results

The sample data used to estimate the model in this chapter also comes from the same Socio-Economic Survey (SES) conducted by the National Statistical Office of Thailand (NSO) in year 2006 used in chapters one and two. The reader is referred to the data section in chapter one to see how the data are collected. The sample is only limited to three types of households (single female, single male and married couples with no child) with each individual being a full-time wage and salary earner. Thus, our sample consists of 810 single females, 825 single males, and 1108 childless couples. The vectors $\mathbf{z}_f$ and $\mathbf{z}_m$ consist of two demographic variables, age and years of formal education. I normalize $\mathbf{z}_f$ and $\mathbf{z}_m$ to zero by subtracting 35 from age, and 9 from years of formal education for a reference set of characteristics. I also define distribution factors $\mathbf{z}_h$ to be the demeaned female's share of gross household income (the mean is 0.45). In addition, I decide to totally drop the budget share on education category out of the estimated models because there are only 1% of single female and 2% of single male reported to have positive expenditures on education. Thus, I estimate the system of budget shares using NLSUR for $K = 11$ non-durable categories, and the omitted category is healthcare. Table 14 provides the main overall descriptive statistics of the sample.

Table 15 reports the estimated parameters for the collective household that enter the scale economies D_f and D_m, and resource shares η functions.[12] For an individual aged 35 with nine years of formal education, scale economies for female and male are given by $\exp(d_{0,f})$ and

[12] Estimates for the hundreds of parameters of the model comprising the singles' budget share equations for each model are available upon request from the author. Moreover, I also compute ranks of the $2\times K$ matrices consisting of rows $[b_j^k, b_m^k]$ and $[c_j^k, c_m^k]$ for identification purpose using Stata. The results show that each matrix has rank two; thus satisfying Theorem 1 in LP.

$\exp(d_{0,m})$, respectively. Notice that, in principle, one should expect the scale economy to lie between 0.5 (completely sharing of consumption) and 1 (purely private consumption). I first consider the estimated parameters from Model A. Model A estimates the couple models developed in section 3.3. The results for Model A give scale economies of 0.88 for female and 1.86 for male of this type in the married-couple households. Even though the scale economy for female is reasonable in magnitude, the scale economy for male clearly is not. These point estimates imply that for a female aged 35 with 9 years of formal education, the cost of living as a member (wife) of the household equals 88% of the costs if she should live alone (single). On the other hand, a married male (husband) faces a much higher cost of living of 186% compared to when he lives alone.

There may be two possible explanations that cause the scale economy for husband to lie outside the 0.5 – 1 range. The first possibility is that it is common in Thai society for husbands to provide housing and some personal expenses for their wives even when wives work full time. As a result, married males would require higher income to be as well off as they were living alone. The second possibility is that these scale economies are imprecisely estimated as we may see that they are not statistically significant at any level. As pointed out by Bargain et al. (2010), which uses the model similar to LP to estimate the measurement of child costs using data from Ireland, that the estimated parameters may be sensitive to model specifications. Thus, I estimate Model B where the resource shares η are now specified using the logistic form as $\eta(\mathbf{z}) = \dfrac{\exp(\mathbf{r}'\mathbf{z})}{1+\exp(\mathbf{r}'\mathbf{z})}$ used by Bargain et al. (2010). The main difference of using the logistic form for the resource shares is that now the resource shares are bounded between zero and one, which was not the case in Model A. However, the scale economies are still not statistically significant at any level in model B.[13]

In addition, demographics affect the demand of single individuals, and so should also affect their scale economies when living in married couple households. The negative and significant coefficient on $d_{age,f}$ suggests that older females in married couples have smaller scale economies (more negative $\ln D_f$) than younger females in married couples, while none of the remaining coefficients on the demographic variables are significant; hence, no discernible effect on scale economies.

The resource shares η are more precisely estimated than the scale economies, and the estimates are more stable across Models A and B. In Model A, the parameter r_0 gives the resource share η of a female (wife) aged 35 with 9 years of formal education in a married-couple household, while for Model B it equals $\exp(r_0)$. The estimated resource shares for a wife equal 0.649 and 0.644 for Models A and B, and they are both significant at 1% and 5% respectively. These results are different than those found by LP and Lise and Seitz (2011) that females have resource shares less than 0.5. However, these results are more in line with BCL and Bargain et al. (2010) that female's resource shares are in the neighborhood of 0.6. Notice from Models A and B that the precisions of the estimates of the r_0 coefficient are very impressive even though I am not able to incorporate the use of assignable goods. This ability to identify and estimate the resource shares without the presence of assignable goods is an interesting finding because it implies that we may be able to use household-level data to recover some of the

[13] I also estimate Models A and B using different initial values for r_0 and find that the estimated results are relatively stable across the values with no evidence of multiple local minima.

individual decision-making process parameters, which rarely occurred in the earlier literature of collective household model.

For the effect of demographic variables on the resource share, Models A and B show that the wife's share of gross household income and husband's education level have no significant effects on the resource shares, while wife's education and ages of both spouses do. The positive value of $r_{educ,f}$ implies that the wives with higher education have larger resource shares compared to wives with only Junior High School qualification. This is somewhat expected since we should anticipate that wives' ability to extract resources within the household would be larger when they are more educated. The negative coefficients on $r_{age,f}$ and $r_{age,m}$ imply that, ceteris paribus, older wives tend to have smaller resource shares compared to younger wives, and also receive smaller resource shares when their husbands get older. These results are interesting because they simply demonstrate that older wives have less bargaining power within the household while older husbands possess more power, which is very common in Thai society.

I estimate two more models using instrumental variables for log total household expenditure. First, I run a linear regression to predict log total expenditure for each type of household by regressing log total expenditure on log total income and all explanatory variables, their square and interaction terms, then substituting the predicted value of log total expenditure into singles' and couples' household models. After that, I estimate the couple's model using NLSUR. Models C and D provide the estimated parameters after controlling for the endogeneity of total household expenditures.[14]

[14] I have estimated more specifications than Models C and D reported here, including different instruments. In particular, I experience that all models are very sensitive to the choice of instruments because the estimates are

The estimated parameters from Models C and D are exceedingly different from each other and also different than the results obtained from Models A and B. These findings are similar to the results found by BCL which estimates the resource shares using GMM estimations and finds that the estimated models are sensitive to the choice of instruments. Bargain et al. (2010) also find that the share of children which is interpreted as the cost of children is relatively stable across specifications without endogeneity correction, but unstable when the endogeneity of total expenditure is controlled for.

Finally, indifference scales, which are used to adjust household income that puts a single individual on the same indifferent curve they would attain when they were married, can be obtained by dividing the scale economy with the resource share. Since the estimated parameters from Models C and D are relatively unstable, then I only interpret the results obtained from Models A and B. Therefore, given the estimates from Model A, a female aged 35 with 9 years of formal education has an estimated indifference scale of (0.88/0.649) = 1.36. This implies that this female when living alone would need approximately (1/1.36) = 74% of the couple's income to reach the same indifference curve that she would attain as a wife in the married-couple household. From Model B, the indifference scale of such female would equal to (0.85/0.644) = 1.32. This implies that when living alone she would need (1/1.32) = 76% of the couple's income to attain the same indifference curve that she would attain as a wife in the married-couple household. Therefore, the estimates are relatively stable between Models A and B regardless of the functional form of the resource shares.

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relatively unstable across all specifications. The estimated parameters from models with different instruments are available upon request from the author.

3.5. Conclusions

The success of the collective approach to household behavior has been recognized and there is growing interest in using it to make inequality or welfare comparisons between individuals. Survey data are generally collected at the household level and welfare or inequality statements are usually measured at this level. This chapter estimates systems of Engel curves developed by Lewbel and Pendakur (2008) using household consumption data to recover many of the objects of interest, especially resource shares and indifference scales of the individuals who together make up the household in the collective framework.

Even though the estimates of scale economies are imprecise, I find relatively stable and more precise results for the resource shares. Using Thai consumption data, I find that wives aged 35 with Junior High School diplomas have resource shares equal to nearly 65% of married-couple's total incomes, while higher educated wives have larger resource shares. Resource shares for wives are smaller for older-married compared to younger-married couples. Moreover, if a female were to live alone, she would need approximately three-quarters of the couple's income to reach the same indifference curve, and hence the same standard of living, that she would attain as a wife in the married-couple household.

Finally, the readers should be cautious that the estimated model in this chapter assumes that there is no change in preferences from being single to being married, so that differences between the consumption behaviors of singles versus couples are due to sharing of household goods and the allocation of household resources to husbands and wives. Therefore, there are opportunities for us to examine the situation where we allow individual's preferences to change after marriage. This may be done by acquiring additional data which include direct observations of the resource allocation and separate consumption of some goods by individuals within the household. I will leave these opportunities for my future research.

Table 1. Descriptive Statistics for all 2933 households

Variable	Mean	Std. Dev.	Min	Max
Household characteristics:				
Household size	3.06	1.04	2	9
Number of young children (age 0-5)	0.23	0.48	0	3
Number of older children (age 6-14)	0.52	0.73	0	4
Husband age	39.06	9.50	18	75
Wife age	36.61	9.18	16	76
Husband education (year)	10.66	4.74	0	22
Wife education (year)	10.67	4.86	0	22
Central	0.43	0.50	0	1
North	0.16	0.37	0	1
Northeastern	0.17	0.37	0	1
South	0.12	0.32	0	1
Rural	0.25	0.43	0	1
Monthly income (in hundred):				
Husband wages	127.02	110.54	10	2000
Wife wages	102.89	92.52	5	1200
Total household income	230.36	190.53	30	3000
Total household consumption	180.87	134.37	15.86	2077.95
Share of monthly consumption expenditure (%) on:				
Housing	15.22	7.45	1.25	64.90
Household operations	7.02	3.55	0.00	43.34
Clothing & Footwear	3.89	4.66	0.00	30.62
Personal & Services	3.85	3.20	0.00	29.53
Cosmetic	0.72	1.30	0.00	21.60
Health	1.50	3.64	0.00	58.86
Transportation & Communication	18.83	9.36	0.00	60.46
Education	1.92	3.42	0.00	46.61
Recreation & Religion	1.86	2.36	0.00	25.03
Food eaten at home	28.91	11.52	2.76	78.56
Food eaten outside	11.99	8.41	0.00	73.97
Alcohol & Tobacco	4.29	5.86	0.00	48.40

Table 2. Quasi-quadratic Engel curve (unitary model) with all household compositions

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	3.372138	-3.544552***	-3.425716***	1.040187	-0.179794	-3.260877**	-6.88292***	-7.599359***	-1.683796**	4.619832**	11.28793***	6.730615***	
	(2.771189)	(1.161005)	(1.262572)	(1.102068)	(0.419679)	(1.530563)	(2.558455)	(1.134348)	(0.754496)	(2.161818)	(1.792946)	(1.376926)	
Household size	2.447597***	2.564208***	-0.0409	0.376319	-0.15319	1.234883***	3.356849***	3.888807***	0.236848	4.347187***	2.897741***	-0.703404**	3.06
	(0.681573)	(0.285549)	(0.310529)	(0.271054)	(0.10322)	(0.376442)	(0.629252)	(0.278993)	(0.185568)	(0.531699)	(0.440975)	(0.338655)	
Young children	-1.589591	-1.026734**	0.134926	3.445435***	-0.096855	-0.226032	-4.39009***	-3.673807***	-0.481955	4.625384***	-4.673697***	0.186806	0.23
	(1.092827)	(0.457846)	(0.497899)	(0.434604)	(0.165502)	(0.603582)	(1.008934)	(0.447333)	(0.297538)	(0.852519)	(0.707054)	(0.542995)	
Older children	-3.625263***	-1.17483***	1.032571***	-0.231981	0.296514**	-1.3709***	-1.464415*	-1.011194***	-0.193489	1.182416*	-1.389984**	0.891497**	0.52
	(0.84927)	(0.355807)	(0.386933)	(0.337745)	(0.128617)	(0.469063)	(0.784075)	(0.347637)	(0.231226)	(0.66252)	(0.549474)	(0.421979)	
Home owner	8.14947***	0.84844**	0.348138	0.050001	0.266619*	0.339861	2.776233***	0.158661	0.310584	0.195594	0.993778	-1.288352***	0.52
	(0.949202)	(0.397674)	(0.432463)	(0.377486)	(0.143751)	(0.524256)	(0.876335)	(0.388543)	(0.258434)	(0.740477)	(0.614129)	(0.471632)	
Vehicle owner	2.540932**	0.677995	0.197072	0.600068	0.075258	-0.249856	6.221644***	0.598133	0.781221**	0.550239	-0.539082	1.021934*	0.84
	(1.214085)	(0.508648)	(0.553145)	(0.482827)	(0.183865)	(0.670555)	(1.120884)	(0.496969)	(0.330552)	(0.947114)	(0.785507)	(0.603245)	
Husband age	-0.006849	0.010381	-0.011194	0.019292	0.001016	-0.033626	-0.022414	-0.068897*	-0.003161	0.004177	-0.081277	-0.05291	39.06
	(0.090533)	(0.037929)	(0.041247)	(0.036004)	(0.013711)	(0.050002)	(0.083583)	(0.037058)	(0.024649)	(0.070625)	(0.058574)	(0.044983)	
Wife age	0.047777	0.036399	-0.008162	-0.004031	0.015171	0.060417	-0.024021	0.047264	0.008486	0.127181*	-0.082988	0.017163	36.61
	(0.094195)	(0.039464)	(0.042916)	(0.03746)	(0.014265)	(0.052025)	(0.086964)	(0.038557)	(0.025646)	(0.073482)	(0.060944)	(0.046803)	
Husband education (year)	0.479061***	0.177061***	0.191239***	0.15934***	0.077989***	-0.037529	0.830384***	0.081944	0.06427	0.308441***	0.039309	-0.057936	10.66
	(0.151295)	(0.063386)	(0.068931)	(0.060168)	(0.022913)	(0.083562)	(0.139681)	(0.06193)	(0.041192)	(0.118026)	(0.097887)	(0.075174)	
Wife education (year)	0.267743*	0.165649***	0.153866**	0.272587***	0.150354***	0.146969*	0.534765***	-0.04894	0.010332	0.416592***	0.366237***	-0.103904	10.67
	(0.14769)	(0.061875)	(0.067288)	(0.058734)	(0.022367)	(0.081571)	(0.136352)	(0.060455)	(0.040211)	(0.115213)	(0.095555)	(0.073383)	
HH total income	0.043892***	0.008802***	0.020388***	-0.014558***	-0.011187***	0.015244***	0.065756***	0.013161***	0.015308***	0.039987***	0.028739***	0.016858***	230.36
	(0.005817)	(0.002437)	(0.00265)	(0.002313)	(0.000881)	(0.003213)	(0.00537)	(0.002381)	(0.001584)	(0.004538)	(0.003763)	(0.00289)	
HH total income square	0.000004	0.000013***	0.000003**	0.000033***	0.000016***	-0.000005***	0.000042***	0.000008***	0.00000004	-0.000008***	-0.000001	-0.000006***	89354.57
	(0.000003)	(0.000001)	(0.000002)	(0.000001)	(0.000001)	(0.000002)	(0.000003)	(0.000001)	(0.000001)	(0.000003)	(0.000002)	(0.000002)	
Central	-9.965106***	-1.459253***	2.396331***	-1.720148***	-0.149259	-1.529792**	-4.549628***	-2.209069***	0.127183	-0.20371	-2.86346***	0.972466	0.43
	(1.359943)	(0.569756)	(0.619599)	(0.540833)	(0.205955)	(0.751114)	(1.255545)	(0.556674)	(0.370264)	(1.060898)	(0.879876)	(0.675717)	
North	-13.95853***	-2.419238***	2.785889***	-2.662457***	-0.062684	-1.47304*	-12.04932***	-2.537374***	-0.839094*	-3.316868***	-8.284594***	0.193504	0.16
	(1.602706)	(0.671463)	(0.730204)	(0.637377)	(0.24272)	(0.885195)	(1.479672)	(0.656045)	(0.436359)	(1.250278)	(1.036943)	(0.79634)	
Northeast	-17.47446***	-4.382593***	1.074179	-2.603857***	-0.251059	-3.473658***	-12.57153***	-5.038213***	-1.628048***	-3.539661***	-10.18***	0.985452	0.17
	(1.616982)	(0.677444)	(0.736708)	(0.643054)	(0.244882)	(0.89308)	(1.492852)	(0.661889)	(0.440246)	(1.261415)	(1.046179)	(0.803433)	
South	-11.78578***	-3.385955***	2.519596***	-2.58823***	-0.290252	-1.747585*	-9.459163***	-2.664688***	-1.223181***	-0.040938	-4.690447***	0.466601	0.12
	(1.715201)	(0.718593)	(0.781457)	(0.682114)	(0.259756)	(0.947327)	(1.583531)	(0.702094)	(0.466988)	(1.338036)	(1.109726)	(0.852235)	
Rural	-0.767361	-0.803638*	-0.469672	-0.278107	-0.143367	-0.472445	-0.26324	-0.342626	-0.467508*	-1.325718*	-1.86976***	0.130535	0.25
	(0.991641)	(0.415454)	(0.451798)	(0.394364)	(0.150178)	(0.547696)	(0.915517)	(0.405915)	(0.269988)	(0.773584)	(0.641587)	(0.492719)	
R-squared	0.3105	0.3400	0.2607	0.3965	0.4179	0.0597	0.6450	0.3051	0.2489	0.3299	0.2237	0.0263	
Number of households	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933

[1] Standard error in parentheses
[2] *** Significant at 1%
** Significant at 5%
* Significant at 10%
[3] Incomes in 100 baht
[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Table 3. QUAIDS Engel curve (unitary model) with all household compositions (SURE)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	47.95122***	28.6071***	-11.72575**	14.9885***	-0.279357	-63.56146***	-0.661715	2.169561	122.5616***	-39.63972***	-14.4352***	
	(7.568327)	(3.644231)	(4.680457)	(3.244211)	(1.32222)	(8.380295)	(3.13245)	(2.373891)	(9.535993)	(8.305295)	(5.998765)	
Household size	-0.422973	0.647975***	-0.673187***	-0.271705***	-0.154844***	-0.756311***	1.4795***	-0.231708***	0.76068***	0.502355**	-0.897427**	3.06
	(0.233604)	(0.112483)	(0.144467)	(0.100136)	(0.040812)	(0.258667)	(0.096686)	(0.073273)	(0.294338)	(0.256352)	(0.185158)	
Young children	-0.189286	0.196662	0.38417*	1.823501***	-0.101049	-1.846728***	-1.359492***	-0.163269	4.251885***	-3.332964***	0.072893	0.23
	(0.366663)	(0.176552)	(0.226754)	(0.157173)	(0.064058)	(0.406001)	(0.151758)	(0.115008)	(0.461991)	(0.402367)	(0.290623)	
Older children	-0.863702***	-0.299925**	0.663647***	0.070154	0.035162	-0.5121	-0.110872	0.003563	1.535698***	-0.690937**	0.370314	0.52
	(0.2851)	(0.137279)	(0.176314)	(0.12221)	(0.049808)	(0.315687)	(0.118)	(0.089425)	(0.359223)	(0.312862)	(0.225975)	
Home owner	3.386533***	0.232454	-0.227118	-0.2422*	0.027776	-0.014805	-0.08216	-0.087766	-0.839084**	-0.835992**	-1.156135***	0.52
	(0.320278)	(0.154217)	(0.198069)	(0.137289)	(0.055954)	(0.354639)	(0.13256)	(0.100459)	(0.403546)	(0.351465)	(0.253857)	
Vehicle owner	0.038214	-0.065912	-0.162627	-0.085155	-0.008825	2.964907***	0.159562	0.351926***	-0.630297	-2.435099***	-0.100494	0.84
	(0.410944)	(0.197874)	(0.254139)	(0.176154)	(0.071794)	(0.455032)	(0.170085)	(0.128897)	(0.517784)	(0.450959)	(0.32572)	
Husband age	0.075287**	0.015614	0.005437	-0.008224	-0.002294	0.060732*	-0.006356	0.013818	0.021935	-0.121565***	-0.055555**	39.06
	(0.030032)	(0.014461)	(0.018573)	(0.012874)	(0.005247)	(0.033254)	(0.01243)	(0.00942)	(0.03784)	(0.032957)	(0.023804)	
Wife age	-0.015054	0.025003*	-0.012177	-0.018767	-0.008871	0.010027	0.033088**	0.002977	0.030416	-0.071633**	0.016777	36.61
	(0.031297)	(0.01507)	(0.019355)	(0.013416)	(0.005468)	(0.034655)	(0.012954)	(0.009817)	(0.039434)	(0.034345)	(0.024807)	
Husband education (year)	0.192609***	0.017355	0.020657	-0.006757	0.002794	0.34288***	0.020463	0.035466**	-0.214644***	-0.157405***	-0.193043***	10.66
	(0.049827)	(0.023992)	(0.030814)	(0.021359)	(0.008705)	(0.055173)	(0.020623)	(0.015629)	(0.062782)	(0.054679)	(0.039494)	
Wife education (year)	0.040917	0.038578	0.01635	0.040819*	0.025513***	0.23447***	-0.014003	-0.001075	-0.20934***	-0.011567	-0.200145***	10.67
	(0.048954)	(0.023572)	(0.030274)	(0.020984)	(0.008552)	(0.054206)	(0.020261)	(0.015355)	(0.061681)	(0.053721)	(0.038801)	
Log (household total consumption)	-11.40674***	-8.609631***	3.911027**	-4.29764***	0.111265	26.79339***	-1.925881	-1.432116	-29.80317***	24.72721***	8.343684***	4.89
	(3.032674)	(1.460265)	(1.875487)	(1.299975)	(0.529821)	(3.358035)	(1.255192)	(0.951232)	(3.82113)	(3.327982)	(2.403741)	
Log (hh total consumption) square	0.871901***	0.689185***	-0.157129	0.470327***	0.040062	-2.304151***	0.297368**	0.245216***	2.026401***	-2.346334***	-0.606255**	24.25
	(0.301982)	(0.145408)	(0.186754)	(0.129447)	(0.052758)	(0.33438)	(0.124987)	(0.09472)	(0.380494)	(0.331388)	(0.239356)	
Central	-2.561366***	-0.053644	1.760144***	-0.411262**	0.000633	-1.465686***	-0.532324***	0.412813***	2.00351***	-0.57566	1.462926***	0.43
	(0.457673)	(0.220375)	(0.283037)	(0.196185)	(0.079958)	(0.506775)	(0.189426)	(0.143554)	(0.576662)	(0.502239)	(0.362758)	
North	-4.093137***	-0.101006	3.044569***	-0.292014	0.176343*	-2.132306***	-0.037834	0.37397**	3.021543***	-2.003164***	1.683812***	0.16
	(0.554452)	(0.266975)	(0.342888)	(0.237669)	(0.096865)	(0.613936)	(0.229482)	(0.17391)	(0.698602)	(0.608442)	(0.439467)	
Northeast	-4.163578***	-0.40101	2.632196***	-0.021434	0.243642**	-1.601606***	-1.023438***	0.127592	3.817403***	-2.236195***	2.597241***	0.17
	(0.561907)	(0.270564)	(0.347498)	(0.240865)	(0.098168)	(0.622191)	(0.232567)	(0.176248)	(0.707995)	(0.616623)	(0.445375)	
South	-2.247507***	-0.638355**	2.472685***	-0.582481**	-0.006619	-2.594735***	-0.417596*	-0.061485	3.638793***	-1.250661**	1.398328***	0.12
	(0.580158)	(0.279352)	(0.358785)	(0.248688)	(0.101356)	(0.6424)	(0.240121)	(0.181973)	(0.730991)	(0.636651)	(0.459841)	
Rural	-0.927423***	-0.190953	0.164484	-0.008971	-0.016366	1.320277***	-0.122081	-0.07543	0.212248	-0.60705*	0.315895	0.25
	(0.334023)	(0.160836)	(0.206569)	(0.143181)	(0.058355)	(0.369859)	(0.138249)	(0.10477)	(0.420864)	(0.366548)	(0.264751)	
R-squared	0.0868	0.0701	0.1089	0.0903	0.0916	0.2919	0.2605	0.1070	0.3945	0.1377	0.0742	
Number of households	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Table 4. QUAIDS Engel curve (unitary model) with all household compositions (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	10.72154	28.43179***	1.473448	23.32235***	1.445582	-76.86008***	2.074284	1.86969	151.4285***	-30.57731**	-14.63786	
	(12.60288)	(6.04125)	(7.783365)	(5.386769)	(2.194414)	(14.48936)	(5.193334)	(3.934851)	(16.02402)	(13.76865)	(9.980853)	
Household size	-0.532857**	0.624349***	-0.56318***	-0.225477**	-0.174205***	-1.619468***	1.463474***	-0.223764***	1.297742***	0.518199*	-0.71634***	3.06
	(0.246086)	(0.117962)	(0.151979)	(0.105183)	(0.042849)	(0.282922)	(0.101406)	(0.076833)	(0.312888)	(0.268849)	(0.194888)	
Young children	-0.130749	0.207885	0.329759	1.80015***	-0.092178	-1.43551***	-1.352377***	-0.16698	3.992437***	-3.342047***	-0.012858	0.23
	(0.370093)	(0.177406)	(0.228564)	(0.158187)	(0.064441)	(0.425491)	(0.152506)	(0.11555)	(0.470557)	(0.404327)	(0.293095)	
Older children	-0.852595***	-0.290859***	0.631994***	0.05923	0.044185	-0.186742	-0.102287	0.000209	1.350824***	-0.689387**	0.299502	0.52
	(0.287764)	(0.137941)	(0.177719)	(0.122997)	(0.050106)	(0.330839)	(0.118581)	(0.089845)	(0.36588)	(0.314383)	(0.227895)	
Home owner	3.393007***	0.213303	-0.170438	-0.225695	0.00718	-0.696379*	-0.102641	-0.080385	-0.469036	-0.846619**	-1.005292***	0.52
	(0.327226)	(0.156858)	(0.202091)	(0.139864)	(0.056977)	(0.376208)	(0.134842)	(0.102166)	(0.416054)	(0.357495)	(0.259147)	
Vehicle owner	-0.209365	-0.092296	0.002683	-0.006129	-0.024038	1.977352***	0.151455	0.359568***	0.054778	-2.386732***	0.096429	0.84
	(0.423987)	(0.20324)	(0.261848)	(0.181222)	(0.073825)	(0.487452)	(0.174714)	(0.132377)	(0.539081)	(0.463206)	(0.335776)	
Husband age	0.070877**	0.014561	0.010175	-0.00627	-0.003182	0.02235	-0.007109	0.014176	0.045541	-0.120979***	-0.047463**	39.06
	(0.030349)	(0.014548)	(0.018743)	(0.012972)	(0.005284)	(0.034892)	(0.012506)	(0.009476)	(0.038588)	(0.033157)	(0.024035)	
Wife age	-0.016779	0.023464	-0.006859	-0.016947	-0.010411*	-0.04517	0.031618**	0.003548	0.061688	-0.071935**	0.028804	36.61
	(0.031792)	(0.01524)	(0.019635)	(0.013589)	(0.005536)	(0.036551)	(0.013101)	(0.009926)	(0.040423)	(0.034733)	(0.025178)	
Husband education (year)	0.151391***	0.010044	0.057152*	0.009132	-0.002827	0.074408	0.016069	0.037854**	-0.043519	-0.15073**	-0.137311***	10.66
	(0.055276)	(0.026497)	(0.034138)	(0.023626)	(0.009625)	(0.06355)	(0.022778)	(0.017258)	(0.070281)	(0.060389)	(0.043776)	
Wife education (year)	-0.008237	0.031064	0.05617*	0.05864**	0.020084**	-0.042763	-0.017987	0.001312	-0.028812	-0.003039	-0.14315***	10.67
	(0.055052)	(0.02639)	(0.034)	(0.023531)	(0.009586)	(0.063293)	(0.022686)	(0.017188)	(0.069997)	(0.060145)	(0.043599)	
Log (household total consumption)	3.35555	-8.604784***	-1.123895	-7.541647***	-0.64113	29.761***	-3.078201	-1.288504	-39.98503***	21.10328***	8.932455**	4.89
	(5.039183)	(2.415557)	(3.112131)	(2.153867)	(0.877423)	(5.793484)	(2.076523)	(1.573326)	(6.407107)	(5.505312)	(3.990784)	
Log (hh total consumption) square	-0.509783	0.707771***	0.255578	0.75613***	0.13063	-1.903072***	0.425077**	0.2245	2.60708***	-1.998167***	-0.811055**	24.25
	(0.493966)	(0.236785)	(0.305067)	(0.211133)	(0.086009)	(0.567907)	(0.203551)	(0.154225)	(0.628057)	(0.539659)	(0.391197)	
Central	-2.466828***	-0.015069	1.609393***	-0.468116**	0.036599	-0.072439	-0.499503**	0.399005***	1.184621**	-0.580681	1.163655***	0.43
	(0.474597)	(0.2275)	(0.293105)	(0.202854)	(0.082637)	(0.545638)	(0.19557)	(0.148178)	(0.60343)	(0.518498)	(0.375857)	
North	-3.601858***	-0.022107	2.634928***	-0.473673*	0.234616**	0.773703	0.005937	0.348666*	1.143099	-2.086615***	1.084362**	0.16
	(0.613558)	(0.294112)	(0.378925)	(0.262249)	(0.106833)	(0.7054)	(0.252832)	(0.191564)	(0.780113)	(0.670313)	(0.485908)	
Northeast	-3.852929***	-0.312825	2.255429***	-0.172148	0.321011***	1.601284**	-0.955821***	0.096959	1.880809**	-2.270894***	1.917113***	0.17
	(0.626252)	(0.300197)	(0.386765)	(0.267675)	(0.109043)	(0.719994)	(0.258063)	(0.195527)	(0.796252)	(0.68418)	(0.49596)	
South	-2.112054***	-0.580407**	2.248458***	-0.666446***	0.047747	-0.503042	-0.367779	-0.082292	2.413141***	-1.256592*	0.948483**	0.12
	(0.609004)	(0.291929)	(0.376112)	(0.260303)	(0.10604)	(0.700163)	(0.250955)	(0.190142)	(0.774322)	(0.665337)	(0.482301)	
Rural	-0.804547**	-0.178784	0.085283	-0.047326	-0.009795	1.777432***	-0.119022	-0.078869	-0.109677	-0.631491*	0.225432	0.25
	(0.338702)	(0.162358)	(0.209178)	(0.144769)	(0.058975)	(0.389401)	(0.139571)	(0.105749)	(0.430645)	(0.370032)	(0.268235)	
R-squared	0.0782	0.0698	0.1030	0.0870	0.0892	0.2295	0.2601	0.1069	0.3777	0.1373	0.0671	
Number of households	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Table 5. Quasi-quadratic Engel curve (monthly expenditures on monthly incomes) with all household compositions

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	3.963707	-3.589473***	-3.157096	1.074747	-0.07391	-3.093508**	-6.756507***	-8.005282***	-1.512694**	4.863536**	11.16771***	6.584779***	
	(2.760838)	(1.16188)	(1.263553)	(1.080833)	(0.413369)	(1.531739)	(2.532665)	(1.128518)	(0.754191)	(2.165687)	(1.798459)	(1.37511)	
Household size	2.235393***	2.534827***	-0.042719	0.459701*	-0.094958	1.232468***	3.413266***	3.804653***	0.275645	4.315569***	2.908493***	-0.789491**	3.06
	(0.678869)	(0.285698)	(0.310698)	(0.265769)	(0.101644)	(0.376643)	(0.622764)	(0.277494)	(0.18545)	(0.532526)	(0.442228)	(0.338129)	
Young children	-1.51615	-1.013693**	0.144808	3.391352***	-0.167245	-0.239971	-4.599473***	-3.656585***	-0.509749*	4.588048***	-4.68427***	0.164081	0.23
	(1.085796)	(0.45695)	(0.496937)	(0.425075)	(0.162572)	(0.60241)	(0.996059)	(0.443829)	(0.296612)	(0.851733)	(0.707307)	(0.54081)	
Older children	-3.429768***	-1.202633***	1.032985***	-0.383093	0.216187*	-1.37688***	-1.770607**	-0.998616***	-0.240296	1.116322*	-1.433383***	0.859421**	0.52
	(0.844576)	(0.355434)	(0.386537)	(0.330641)	(0.126455)	(0.468579)	(0.774775)	(0.345228)	(0.230717)	(0.662512)	(0.550172)	(0.420664)	
Home owner	8.074346***	0.889971**	0.370002	0.014664	0.239553*	0.287876	2.684924***	0.158721	0.297086	0.211884	1.02406*	-1.276497***	0.52
	(0.942782)	(0.396763)	(0.431483)	(0.369087)	(0.141159)	(0.523064)	(0.864864)	(0.385371)	(0.257544)	(0.739547)	(0.614145)	(0.469578)	
Vehicle owner	2.370711**	0.636507	0.160124	0.608288	0.092017	-0.267524	6.155476***	0.573013	0.779263**	0.466741	-0.537502	0.9499	0.84
	(1.205911)	(0.5075)	(0.551909)	(0.472099)	(0.180556)	(0.669051)	(1.106247)	(0.492927)	(0.329425)	(0.945954)	(0.785552)	(0.600637)	
Husband age	-0.000098	-0.005168	-0.014023	0.017724	0.001766	-0.026006	-0.048381	-0.08237**	-0.001134	-0.014618	-0.091326	-0.076409*	39.06
	(0.090657)	(0.038153)	(0.041491)	(0.035491)	(0.013574)	(0.050298)	(0.083165)	(0.037057)	(0.024765)	(0.071115)	(0.059056)	(0.045154)	
Wife age	0.035708	0.056522	-0.008428	-0.012777	0.004638	0.045113	-0.023026	0.071377*	-0.000746	0.14039*	-0.069918	0.044719	36.61
	(0.095039)	(0.039996)	(0.043496)	(0.037206)	(0.01423)	(0.052728)	(0.087184)	(0.038848)	(0.025962)	(0.074551)	(0.06191)	(0.047337)	
Husband education (year)	0.508616***	0.138323**	0.181139***	0.151066**	0.078805***	-0.017102	0.772128***	0.056745	0.066644	0.263216**	0.013361	-0.108264	10.66
	(0.152735)	(0.064278)	(0.069902)	(0.059794)	(0.022868)	(0.084739)	(0.140112)	(0.062432)	(0.041723)	(0.11981)	(0.099494)	(0.076074)	
Wife education (year)	0.275466*	0.221125***	0.173751**	0.229168***	0.10897***	0.105204	0.472965***	-0.009231	-0.012693	0.454687***	0.39377***	-0.048833	10.67
	(0.153842)	(0.064743)	(0.070409)	(0.060227)	(0.023034)	(0.085353)	(0.141127)	(0.062884)	(0.042026)	(0.120678)	(0.100215)	(0.076625)	
Husband wage&salary	-1.607835***	0.204737	-0.151878	0.55228***	-0.152555**	-0.256385	-0.354716	0.155228	-0.034647	-0.358682	0.267628	-0.249067	127.01
	(0.542183)	(0.228174)	(0.248141)	(0.212258)	(0.081179)	(0.300808)	(0.497374)	(0.221622)	(0.148111)	(0.425305)	(0.353188)	(0.270049)	
Wife wage&salary	-1.61341***	0.181121	-0.168279	0.580529***	-0.134436*	-0.234872	-0.309022	0.151387	-0.026346	-0.377565	0.256557	-0.265556	102.89
	(0.542377)	(0.228256)	(0.24823)	(0.212334)	(0.081208)	(0.300916)	(0.497552)	(0.221702)	(0.148164)	(0.425457)	(0.353314)	(0.270146)	
HH total income	1.649388***	-0.186944	0.17684	-0.575369***	0.136864*	0.263478	0.412664	-0.138702	0.047093	0.406965	-0.233641	0.274831	230.36
	(0.542884)	(0.228469)	(0.248462)	(0.212532)	(0.081284)	(0.301197)	(0.498017)	(0.221909)	(0.148302)	(0.425855)	(0.353644)	(0.270398)	
Husband w&s square	0.000596	-0.000339*	-0.000045	-0.001024***	0.000155**	-0.000107	-0.00042	-0.000175	-0.00013	-0.000033	-0.000163	0.000074	28347.76
	(0.000483)	(0.000203)	(0.000221)	(0.000189)	(0.000072)	(0.000268)	(0.000443)	(0.000198)	(0.000132)	(0.000379)	(0.000315)	(0.000241)	
Wife w&s square	0.000652	-0.000329	-0.000028	-0.001086***	0.00012*	-0.000125	-0.000544	-0.000178	-0.000146	-0.000036	-0.000168	0.000071	19143.79
	(0.000483)	(0.000203)	(0.000221)	(0.000189)	(0.000072)	(0.000268)	(0.000443)	(0.000198)	(0.000132)	(0.000379)	(0.000315)	(0.000241)	
HH total income square	-0.000581	0.000339*	0.000011	0.00109***	-0.000126*	0.000126	0.000557	0.000232	0.000125	0.000012	0.000158	-0.000052	89354.57
	(0.000484)	(0.000204)	(0.000222)	(0.00019)	(0.000073)	(0.000269)	(0.000444)	(0.000198)	(0.000132)	(0.00038)	(0.000315)	(0.000241)	
Husws * Wifews	0.001112	-0.000625	0.000067	-0.002154***	0.000276*	-0.000307	-0.001199	-0.000571	-0.000229	-0.000007	-0.000303	0.000022	20782.16
	(0.000972)	(0.000409)	(0.000445)	(0.00038)	(0.000146)	(0.000539)	(0.000891)	(0.000397)	(0.000266)	(0.000762)	(0.000633)	(0.000484)	
Central	-9.84346***	-1.343235**	2.466693***	-1.456942***	-0.148967	-1.448496*	-4.19193***	-2.171126***	0.19168	-0.037154	-2.83658***	1.064201	0.43
	(1.351739)	(0.56887)	(0.61865)	(0.529189)	(0.20239)	(0.749958)	(1.240023)	(0.552536)	(0.369261)	(1.060346)	(0.880547)	(0.67327)	
North	-14.0746***	-2.328121***	2.790796***	-2.396568***	-0.073682	-1.434989	-11.80316***	-2.467345***	-0.802013*	-3.263758***	-8.238306***	0.232886	0.16
	(1.593465)	(0.670599)	(0.729281)	(0.623822)	(0.238583)	(0.88407)	(1.461772)	(0.651344)	(0.435295)	(1.249964)	(1.038012)	(0.793668)	
Northeast	-17.39376***	-4.242463***	1.073636	-2.185902***	-0.230548	-3.346346***	-11.90722***	-4.860208***	-1.563723***	-3.359367***	-10.13231***	1.175689	0.17
	(1.608406)	(0.676887)	(0.736119)	(0.62967)	(0.24082)	(0.892359)	(1.475477)	(0.657451)	(0.439376)	(1.261684)	(1.047744)	(0.80111)	
South	-11.76045***	-3.25191***	2.559185***	-2.238864***	-0.28292	-1.661*	-8.989528***	-2.574189***	-1.156691**	0.119674	-4.642293***	0.583259	0.12
	(1.70486)	(0.717479)	(0.780263)	(0.667431)	(0.255262)	(0.945873)	(1.56396)	(0.696877)	(0.465725)	(1.337345)	(1.110576)	(0.849151)	
Rural	-0.63585	-0.813243**	-0.490091	-0.287725	-0.137682	-0.439161	-0.16428	-0.28987	-0.475797*	-1.305195*	-1.886805***	0.188685	0.25
	(0.984849)	(0.414467)	(0.450736)	(0.385556)	(0.147457)	(0.546404)	(0.903455)	(0.402566)	(0.269036)	(0.772546)	(0.641548)	(0.490531)	
R-squared	0.3208	0.3440	0.2651	0.4239	0.4395	0.0654	0.6547	0.3174	0.2552	0.3326	0.2249	0.0362	
Number of households	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Table 6. QUAIDS Engel curve with all household compositions (SURE)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	48.68685***	28.63959***	-10.6582**	15.33509***	-0.460065	-75.48891***	-0.643023	1.973703	128.6835***	-40.73426***	-10.7644*	
	(7.650512)	(3.68176)	(4.730097)	(3.276996)	(1.336609)	(8.307995)	(3.164829)	(2.399664)	(9.60752)	(8.389993)	(6.04701)	
Household size	-0.433594*	0.646505***	-0.689461***	-0.276151***	-0.152001***	-0.576672**	1.478401***	-0.228412***	0.667609**	0.521451**	-0.954796***	3.06
	(0.234216)	(0.112715)	(0.144809)	(0.100323)	(0.04092)	(0.254344)	(0.096889)	(0.073464)	(0.294128)	(0.256854)	(0.185125)	
Young children	-0.196503	0.196854	0.374136*	1.819816***	-0.099396	-1.733499***	-1.359252***	-0.161587	4.194212***	-3.323906***	0.039109	0.23
	(0.366747)	(0.176495)	(0.22675)	(0.157091)	(0.064074)	(0.398265)	(0.151714)	(0.115034)	(0.460561)	(0.402196)	(0.289879)	
Older children	-0.866223***	-0.303086**	0.657368***	0.070667	0.036494	-0.448604	-0.113462	0.005662	1.500461***	-0.677154**	0.344425	0.52
	(0.285162)	(0.137232)	(0.176307)	(0.122145)	(0.04982)	(0.309668)	(0.117964)	(0.089444)	(0.358106)	(0.312725)	(0.225393)	
Home owner	3.37835***	0.244156	-0.228629	-0.252787*	0.026967	0.028402	-0.072376	-0.091234	-0.85079**	-0.863503**	-1.144321***	0.52
	(0.320437)	(0.154208)	(0.198117)	(0.137255)	(0.055983)	(0.347976)	(0.132557)	(0.100509)	(0.402406)	(0.35141)	(0.253276)	
Vehicle owner	0.057498	-0.086213	-0.152815	-0.064266	-0.008619	2.809109***	0.142532	0.356693***	-0.568693	-2.394205***	-0.096578	0.84
	(0.411406)	(0.197987)	(0.254361)	(0.17622)	(0.071876)	(0.446763)	(0.170189)	(0.129042)	(0.516644)	(0.451172)	(0.325178)	
Husband age	0.082011***	0.009673	0.009836	-0.001575	-0.002488	-0.002027	-0.011352	0.014947	0.048732	-0.111047***	-0.049227**	39.06
	(0.030772)	(0.014809)	(0.019026)	(0.013181)	(0.005376)	(0.033417)	(0.01273)	(0.009652)	(0.038644)	(0.033747)	(0.024323)	
Wife age	-0.014157	0.028431*	-0.007963	-0.020235	-0.009883*	-0.029655	0.035918***	0.001151	0.053725	-0.084117**	0.036045	36.61
	(0.031915)	(0.015359)	(0.019732)	(0.01367)	(0.005576)	(0.034658)	(0.013203)	(0.010011)	(0.040079)	(0.035)	(0.025226)	
Husband education (year)	0.209899***	0.003606	0.03328	0.009488	0.001938	0.17017***	0.008882	0.037656**	-0.138595**	-0.135387**	-0.170101***	10.66
	(0.052618)	(0.025322)	(0.032532)	(0.022538)	(0.009193)	(0.05714)	(0.021767)	(0.016504)	(0.066077)	(0.057704)	(0.041589)	
Wife education (year)	0.048485	0.047217*	0.034467	0.039751*	0.021714**	0.050182	-0.006932	-0.006977	-0.107543	-0.050146	-0.126142***	10.67
	(0.053997)	(0.025986)	(0.033385)	(0.023129)	(0.009434)	(0.058638)	(0.022337)	(0.016937)	(0.06781)	(0.059217)	(0.04268)	
Log (husband wages)	-0.365298	0.357099*	-0.209475	-0.380373**	0.002509	3.154966***	0.299856*	-0.077435	-1.295362***	-0.684314	-0.194034	4.57
	(0.381077)	(0.183391)	(0.235609)	(0.163229)	(0.066577)	(0.413826)	(0.157642)	(0.119529)	(0.478556)	(0.417911)	(0.301205)	
Log (wife wages)	-0.032525	-0.213189	-0.22912	0.102834	0.057478	2.09775***	-0.176216	0.107772	-1.260507***	0.745009*	-1.086401***	4.34
	(0.361904)	(0.174164)	(0.223755)	(0.155017)	(0.063228)	(0.393006)	(0.149711)	(0.113515)	(0.45448)	(0.396885)	(0.286051)	
Log (household total consumption)	-11.40062***	-8.734673***	3.812251**	-4.224833***	0.139048	27.62351***	-2.029519	-1.375092	-30.33801***	25.13035***	7.82735***	4.89
	(3.037675)	(1.461861)	(1.878109)	(1.301148)	(0.530707)	(3.298732)	(1.256611)	(0.952799)	(3.814714)	(3.331289)	(2.400996)	
Log (hh total consumption) square	0.894458***	0.690615***	-0.124022	0.480713***	0.03442	-2.673096***	0.2983**	0.239008**	2.216143***	-2.381323***	-0.491806**	24.25
	(0.30396)	(0.146279)	(0.18793)	(0.130197)	(0.053104)	(0.330082)	(0.125741)	(0.09534)	(0.381713)	(0.33334)	(0.240252)	
Central	-2.611625***	-0.028242	1.710937***	-0.450354**	0.006524	-0.855629*	-0.510723***	0.413266***	1.714366***	-0.591747	1.332674***	0.43
	(0.460537)	(0.221631)	(0.284737)	(0.197265)	(0.08046)	(0.500116)	(0.190513)	(0.144452)	(0.578343)	(0.505052)	(0.364011)	
North	-4.135648***	-0.094135	2.990392***	-0.316925	0.184741*	-1.507907**	-0.031668	0.381194**	2.708655***	-1.968692***	1.509858***	0.16
	(0.557128)	(0.268114)	(0.344457)	(0.238638)	(0.097335)	(0.605007)	(0.23047)	(0.174749)	(0.699642)	(0.610979)	(0.440357)	
Northeast	-4.193927***	-0.393662	2.595618***	-0.040581	0.249067**	-1.173964*	-1.017013***	0.131605	3.605452***	-2.219622***	2.483716***	0.17
	(0.563042)	(0.27096)	(0.348113)	(0.241171)	(0.098368)	(0.611429)	(0.232917)	(0.176604)	(0.707068)	(0.617464)	(0.445031)	
South	-2.292077***	-0.624878**	2.421274***	-0.612098**	0.000721	-1.986621***	-0.405936*	-0.056848	3.340077***	-1.235157**	1.243326***	0.12
	(0.582412)	(0.280282)	(0.360089)	(0.249469)	(0.101752)	(0.632465)	(0.24093)	(0.18268)	(0.731394)	(0.638707)	(0.460342)	
Rural	-0.928678***	-0.189643	0.163836	-0.010324	-0.016377	1.330499***	-0.120982	-0.075735	0.208186	-0.609675*	0.315592	0.25
	(0.333966)	(0.160719)	(0.206482)	(0.14305)	(0.058347)	(0.362667)	(0.138153)	(0.104752)	(0.419394)	(0.366246)	(0.263969)	
R-squared	0.0871	0.0715	0.1097	0.0920	0.0919	0.3192	0.2615	0.1074	0.3987	0.1391	0.0797	
Number of households	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Table 7. QUAIDS Engel curve with all household compositions (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	-5.904374	30.73023***	4.64221	21.02358***	0.279501	-72.4363***	4.153896	2.318658	161.6928***	-33.89027**	-14.04128	
	(14.74367)	(6.199335)	(8.155155)	(5.523851)	(2.312591)	(14.26579)	(5.334122)	(4.063312)	(17.4495)	(14.12065)	(10.17546)	
Household size	-1.881935***	0.692271***	-0.333993	-0.332179**	-0.262738***	-1.162002***	1.534429***	-0.134622	2.010354***	0.567569	-0.955905***	3.06
	(0.387215)	(0.162814)	(0.21418)	(0.145074)	(0.060736)	(0.374664)	(0.140091)	(0.106715)	(0.458278)	(0.370852)	(0.267239)	
Young children	0.253036	0.182524	0.263156	1.834543***	-0.066702	-1.560395***	-1.377559***	-0.189608	3.783456***	-3.339962***	0.040557	0.23
	(0.428455)	(0.180155)	(0.236991)	(0.160525)	(0.067205)	(0.414568)	(0.155011)	(0.118081)	(0.507087)	(0.41035)	(0.295702)	
Older children	-0.524118	-0.313639**	0.574743***	0.089389	0.066107	-0.292678	-0.124807	-0.018736	1.170915***	-0.684455**	0.342411	0.52
	(0.334239)	(0.140539)	(0.184877)	(0.125226)	(0.052426)	(0.323405)	(0.120925)	(0.092115)	(0.39558)	(0.320115)	(0.230678)	
Home owner	2.47672***	0.271767	-0.011918	-0.306435**	-0.053793	-0.396413	-0.043958	-0.02517	0.027458	-0.847079**	-1.137227***	0.52
	(0.414036)	(0.174092)	(0.229016)	(0.155122)	(0.064943)	(0.400616)	(0.149794)	(0.114107)	(0.490022)	(0.39654)	(0.28575)	
Vehicle owner	-1.297602**	-0.0421	0.186498	-0.089089	-0.094842	2.350323***	0.204453	0.433157***	0.625332	-2.332991***	-0.109062***	0.84
	(0.529301)	(0.222557)	(0.292772)	(0.198307)	(0.083023)	(0.512145)	(0.191496)	(0.145874)	(0.62644)	(0.506934)	(0.365301)	
Husband age	0.114032***	0.00866	0.001975	-0.000345	-0.000045	0.010886	-0.012594	0.012877	0.019065	-0.112072***	-0.049199**	39.06
	(0.035779)	(0.015044)	(0.019791)	(0.013405)	(0.005612)	(0.03462)	(0.012945)	(0.009861)	(0.042346)	(0.034267)	(0.024693)	
Wife age	-0.038992	0.029188*	-0.002014	-0.021794	-0.012159**	-0.041618	0.036673***	0.003004	0.0781*	-0.083718**	0.036274	36.61
	(0.036944)	(0.015534)	(0.020435)	(0.013842)	(0.005795)	(0.035747)	(0.013366)	(0.010182)	(0.043725)	(0.035383)	(0.025498)	
Husband education (year)	0.052115	0.008694	0.072538**	0.005568	-0.00875	0.113436*	0.015737	0.04698**	0.002756	-0.128933**	-0.171127***	10.66
	(0.066766)	(0.028073)	(0.03693)	(0.025014)	(0.010472)	(0.064602)	(0.024155)	(0.0184)	(0.079019)	(0.063944)	(0.046079)	
Wife education (year)	-0.142905**	0.053505*	0.082693**	0.037487	0.010318	-0.010619	0.002241	0.003315	0.058295	-0.040688	-0.12842***	10.67
	(0.07027)	(0.029547)	(0.038868)	(0.026327)	(0.011022)	(0.067993)	(0.025423)	(0.019366)	(0.083166)	(0.067301)	(0.048498)	
Log (husband wages)	-4.745477***	0.495586	0.865965*	-0.548137	-0.331332**	1.390182	0.469878	0.205525	2.761673**	-0.543741	-0.198086	4.57
	(0.94936)	(0.399182)	(0.525119)	(0.355687)	(0.14891)	(0.918589)	(0.34347)	(0.261641)	(1.123591)	(0.909243)	(0.655208)	
Log (wife wages)	-2.421528***	-0.138958	0.350671	-0.01642	-0.142085	1.045857*	-0.093037	0.273452	1.014876	0.803513	-1.077101**	4.34
	(0.637922)	(0.26823)	(0.352853)	(0.239003)	(0.10006)	(0.617245)	(0.230794)	(0.175809)	(0.754996)	(0.610965)	(0.440267)	
Log (household total consumption)	12.42565**	-9.634495***	-2.799869	-6.438017***	-0.01394	27.1591***	-4.03034*	-1.635891	-45.35316***	22.31974***	9.145747**	4.89
	(6.007284)	(2.525909)	(3.322804)	(2.250684)	(0.942262)	(5.812575)	(2.173379)	(1.65559)	(7.109769)	(5.753437)	(4.145974)	
Log (hh total consumption) square	-0.118	0.73725***	0.200644	0.753951***	0.153796*	-2.076409***	0.445005**	0.176803	2.449832***	-2.1446***	-0.622146	24.25
	(0.571954)	(0.240492)	(0.316365)	(0.214288)	(0.089713)	(0.553416)	(0.206928)	(0.157629)	(0.676922)	(0.547785)	(0.394739)	
Central	-1.54991***	-0.061156	1.453661***	-0.395743*	0.096229	-0.382956	-0.547133***	0.338975**	0.699505	-0.616692	1.327872***	0.43
	(0.570377)	(0.239829)	(0.315492)	(0.213697)	(0.089465)	(0.551889)	(0.206357)	(0.157194)	(0.675055)	(0.546274)	(0.39365)	
North	-0.633629	-0.206395	2.122562***	-0.215602	0.430986***	-0.202566	-0.178896	0.168381	-0.460975	-2.102556**	1.526704**	0.16
	(0.909479)	(0.382413)	(0.50306)	(0.340745)	(0.142655)	(0.880001)	(0.329041)	(0.25065)	(1.076391)	(0.871048)	(0.627684)	
Northeast	-0.335596	-0.514921	1.652094***	0.122736	0.552923***	0.430602	-1.161429***	-0.123999	-0.003302	-2.333275**	2.48084***	0.17
	(0.993742)	(0.417843)	(0.549668)	(0.372315)	(0.155872)	(0.961533)	(0.359527)	(0.273873)	(1.176119)	(0.95175)	(0.685839)	
South	-0.291882	-0.687042**	1.935777***	-0.512524*	0.167634	-1.106794	-0.47567*	-0.195453	1.435621	-1.284317*	1.235652**	0.12
	(0.780748)	(0.328284)	(0.431854)	(0.292514)	(0.122463)	(0.755442)	(0.282467)	(0.215172)	(0.924034)	(0.747756)	(0.538839)	
Rural	-0.202394	-0.21328	-0.017993	0.003104	0.029914	1.576791***	-0.154126	-0.116768	-0.432047	-0.642402*	0.322231	0.25
	(0.403761)	(0.169771)	(0.223332)	(0.151273)	(0.063331)	(0.390674)	(0.146077)	(0.111275)	(0.477861)	(0.3867)	(0.278659)	
R-squared	-0.1975	0.0702	0.0653	0.0887	0.0398	0.2910	0.2591	0.0960	0.2995	0.1387	0.0796	
Number of households	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933	2933

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Table 8. Test of income pooling for households consisting of spouses with various household types

Household composition	Engel curve (1.16)[1]	Engel curve (1.17)[2] (3SLS)	Number of households	Average household size
1. Full sample	498.99**	59.70**	2933	3.06
2. Spouses only	338.74**	57.56**	1108	2.00
3. Spouses with kids, no others	302.01**	36.12**	1112	3.48
4. Spouses with others, no kids	116.32**	33.93**	314	3.40
5. Spouses with kids and others	395.72**	30.64	399	4.56
6. Spouses with one dependent	156.61**	57.40**	846	3.00
7. Spouses with two dependents	465.72**	27.56	728	4.00
8. Spouses with three or more dependents	261.70**	19.04	251	5.25

[1] Chi-square value with 60 restrictions
[2] Chi-square value with 22 restrictions
[3] ** Significant at 5%

Table 9. Test of Pareto efficiency for households consisting of spouses with various household types

Household composition	Engel curve (1.16)[1]	Engel curve (1.17)[2] (3SLS)	Number of households	Average household size
1. Full sample	8.34	9.04	2933	3.06
2. Spouses only	11.00	11.32	1108	2.00
3. Spouses with kids, no others	1.97	5.63	1112	3.48
4. Spouses with others, no kids	3.31	3.79	314	3.40
5. Spouses with kids and others	6.14	4.20	399	4.56
6. Spouses with one dependent	1.89	1.70	846	3.00
7. Spouses with two dependents	3.55	4.82	728	4.00
8. Spouses with three or more dependents	4.50	2.70	251	5.25

[1] Chi-square value with 11 restrictions
[2] Chi-square value with 10 restrictions
[3] ** Significant at 5%

Table 10. Descriptive Statistics for all 443 households

Variable	Mean	Std. Dev.	Min	Max
Household characteristics:				
Household size	4.44	1.34	3	10
Number of young children (age 0-5)	0.35	0.59	0	3
Number of older children (age 6-14)	0.45	0.69	0	4
Number of adults (age 15 and up)	3.64	0.80	2	8
Husband age	38.86	10.94	19	69
Wife age	36.66	10.39	16	67
Third member's age	31.46	13.48	14	70
Husband education (year)	9.42	4.70	0	18
Wife education (year)	9.26	4.90	0	18
Third member's education (year)	9.87	4.69	0	18
Central	0.53	0.50	0	1
North	0.14	0.35	0	1
Northeastern	0.11	0.31	0	1
South	0.08	0.28	0	1
Rural	0.29	0.45	0	1
Monthly income (in hundred):				
Husband wages	103.28	102.05	12.00	1200.00
Wife wages	83.96	80.07	15.00	684.36
Third member's wages	76.44	74.85	5.00	670.00
Total household income	264.71	210.54	54.61	1652.85
Total household consumption	178.68	110.01	30.62	984.47
Share of monthly consumption expenditure (%) on:				
Housing	15.48	8.64	3.58	66.69
Household operations	8.71	4.87	1.85	42.04
Clothing & Footwear	3.45	4.04	0.00	35.87
Personal & Services	3.20	1.59	0.00	9.73
Cosmetic	0.69	1.14	0.00	10.25
Health	1.91	4.97	0.00	53.71
Transportation & Communication	31.48	31.55	0.00	281.27
Education	1.92	3.69	0.00	29.28
Recreation & Religion	2.86	3.48	0.00	20.91
Food eaten at home	29.80	11.74	5.94	68.01
Food eaten outside	13.05	8.32	0.00	47.74
Alcohol & Tobacco	4.16	5.38	0.00	26.82

Table 11. QUAIDS Engel curve for households with three decision makers

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	7.107318	24.01806	-16.44577	-1.540109	-4.828334	-287.5581***	-2.825888	10.58926	165.4799***	-31.99983	-20.24162	
	(29.01154)	(16.11496)	(12.92354)	(5.368634)	(3.688389)	(96.81153)	(11.54919)	(11.03114)	(31.04871)	(26.23873)	(17.29697)	
Household size	-0.993192*	0.571185*	-0.020902	0.159764	0.014943	-1.878914	1.155133***	-0.24902	0.117735	-0.678319	-0.107294	4.4424
	(0.570376)	(0.316825)	(0.254081)	(0.105549)	(0.072515)	(1.903344)	(0.227061)	(0.216876)	(0.610427)	(0.515862)	(0.340064)	
Young children	0.966968	-0.492015	-0.431992	-0.292026	-0.197184	3.736004	-1.305326***	0.347102	3.114141***	-0.067498	-0.466171	0.3476
	(1.001336)	(0.55621)	(0.446058)	(0.185299)	(0.127305)	(3.34146)	(0.398622)	(0.380741)	(1.071649)	(0.905633)	(0.597007)	
Older children	-0.008113	-0.308676	-0.364575	-0.201447	-0.068169	-1.696375	-0.046523	-0.048212	0.403591	1.031379	-0.201752	0.4515
	(0.843308)	(0.46843)	(0.375662)	(0.156056)	(0.107214)	(2.81412)	(0.335712)	(0.320654)	(0.902525)	(0.762708)	(0.502789)	
Home owner	1.50093	0.637254	-1.067636**	0.107257	0.19151	1.517246	-0.69682	0.028008	0.806161	-1.087926	-0.928379	0.6930
	(1.075682)	(0.597506)	(0.479176)	(0.199057)	(0.136757)	(3.589551)	(0.428218)	(0.40901)	(1.151216)	(0.972873)	(0.641332)	
Vehicle owner	-1.069316	-0.068714	-0.243325	-0.110631	-0.083524	10.07252**	0.177617	0.824373	-1.193408	0.388856	-0.177711	0.8804
	(1.359768)	(0.755307)	(0.605726)	(0.251627)	(0.172875)	(4.537549)	(0.54131)	(0.517029)	(1.455251)	(1.229807)	(0.810708)	
Husband age	0.115839	0.036517	0.018025	0.002817	0.010644	0.060594	0.014372	-0.004282	0.028956	-0.100403	-0.120739**	38.8623
	(0.080889)	(0.044931)	(0.036033)	(0.014969)	(0.010284)	(0.269926)	(0.032201)	(0.030757)	(0.086569)	(0.073158)	(0.048227)	
Wife age	-0.059563	-0.020455	0.018902	0.001211	-0.020123*	-0.134569	-0.004982	0.01579	0.111898	-0.122174	0.083991	36.6569
	(0.089371)	(0.049643)	(0.039811)	(0.016538)	(0.011362)	(0.29823)	(0.035578)	(0.033982)	(0.095646)	(0.080829)	(0.053284)	
Third member's age	-0.022592	-0.000656	0.005223	0.000219	-0.003513	0.038116	0.017369	-0.010581	0.088899*	-0.087179**	-0.016905	31.4582
	(0.043288)	(0.024045)	(0.019283)	(0.008011)	(0.005503)	(0.144451)	(0.017232)	(0.016459)	(0.046327)	(0.03915)	(0.025809)	
Husband education (year)	0.20384	0.069916	0.130746*	-0.005172	-0.024627	0.492929	-0.006721	0.065364	-0.354475**	-0.190344	-0.11378	9.4199
	(0.16246)	(0.090241)	(0.07237)	(0.030063)	(0.020654)	(0.542128)	(0.064674)	(0.061773)	(0.173868)	(0.146933)	(0.09686)	
Wife education (year)	-0.034585	0.118611	-0.002373	0.048192	0.023706	-0.130761	-0.098033	0.145192**	0.135945**	-0.036204	-0.182322*	9.2641
	(0.167311)	(0.092936)	(0.074531)	(0.030961)	(0.021271)	(0.558315)	(0.066605)	(0.063617)	(0.179059)	(0.15132)	(0.099752)	
Third member's education (year)	-0.203308	-0.164359**	-0.049796	0.014456	-0.003946	0.977063**	0.126298**	0.015983	0.006199	-0.016798	-0.100158	9.8668
	(0.143415)	(0.079662)	(0.063886)	(0.026539)	(0.018233)	(0.478574)	(0.057092)	(0.054531)	(0.153485)	(0.129708)	(0.085505)	
Log (husband wages)	0.404268	0.901467	-0.304353	-0.031188	-0.199823	12.95368***	0.336913	-0.078099	-1.287166	-0.464349	-0.836176	4.3579
	(1.009385)	(0.560681)	(0.449643)	(0.186788)	(0.128328)	(3.368319)	(0.401826)	(0.383802)	(1.080264)	(0.912912)	(0.601806)	
Log (wife wages)	-1.498235	-0.526745	0.014943	-0.110439	0.22737	-2.526553	0.248869	-0.270767	-2.245668*	0.738592	0.923198	4.1602
	(1.222853)	(0.679255)	(0.544735)	(0.226291)	(0.155468)	(4.08066)	(0.486805)	(0.464969)	(1.308721)	(1.105977)	(0.729077)	
Log (third member's wages)	1.685567*	0.368412	0.890306**	-0.075352	0.168295	3.904929	-0.425372	-0.273623	-2.106907**	1.021816	-0.554749	4.1012
	(0.947134)	(0.526102)	(0.421913)	(0.175269)	(0.120414)	(3.160588)	(0.377044)	(0.360132)	(1.013642)	(0.856611)	(0.564691)	
Majorsex	0.339399	-0.056368	-0.757501**	-0.040251	-0.355895***	2.071026	-0.129887	-0.132226	0.059011	-0.334487	1.570238***	0.5756
	(0.854671)	(0.474742)	(0.380723)	(0.158158)	(0.108659)	(2.852037)	(0.340236)	(0.324974)	(0.914685)	(0.772985)	(0.509563)	
Log (household total consumption)	2.012113	-7.613945	4.669607	2.495177	1.887472	99.29768***	-1.43607	-4.331198	-40.48845***	23.97226**	9.980562	5.0462
	(11.08602)	(6.157924)	(4.938404)	(2.051487)	(1.409424)	(36.99407)	(4.413231)	(4.215271)	(11.86448)	(10.02647)	(6.609598)	
Log (hh total consumption) square	-0.031303	0.628649	-0.330624	-0.302568	-0.158849	-10.1126***	0.22602	0.552933	3.200307***	-2.363847**	-0.736439	25.7241
	(1.07983)	(0.59981)	(0.481023)	(0.199824)	(0.137284)	(3.603393)	(0.429869)	(0.410587)	(1.155655)	(0.976624)	(0.643805)	
Central	-1.248773	0.293282	1.734166***	-0.307417	-0.123473	-1.408814	-0.267469	1.087539**	2.894941*	-3.48043***	1.889284**	0.5282
	(1.38704)	(0.770455)	(0.617874)	(0.256674)	(0.176342)	(4.628552)	(0.552166)	(0.527398)	(1.484437)	(1.254472)	(0.826967)	
North	-1.927392	-0.288833	3.374145***	-0.40182	0.04235	8.206729	0.946313	0.763997	3.198797*	-5.427473***	1.958591*	0.1422
	(1.683038)	(0.934873)	(0.74973)	(0.311449)	(0.213974)	(5.6163)	(0.67)	(0.639947)	(1.80122)	(1.52218)	(1.003444)	
Northeast	-1.861888	0.981623	2.803702***	-0.440466	0.262064	4.44106	-0.397002	-0.03906	5.817903***	-4.849196***	2.063846*	0.1106
	(1.789635)	(0.994084)	(0.797215)	(0.331175)	(0.227526)	(5.972015)	(0.712435)	(0.680478)	(1.915302)	(1.618589)	(1.066998)	
South	0.180871	2.565321**	2.123259**	-0.819721**	-0.07906	-1.203179	-0.777414	-0.198965	4.369966**	-4.358759**	0.214936	0.0835
	(1.923171)	(1.068259)	(0.8567)	(0.355886)	(0.244503)	(6.417625)	(0.765595)	(0.731253)	(2.058215)	(1.739362)	(1.146614)	
Rural	1.020385	-0.361457	0.308346	-0.009949	0.042149	1.181881	0.285668	-0.103631	-1.470411	-0.860916	0.196181	0.2867
	(1.001345)	(0.556214)	(0.446061)	(0.185301)	(0.127306)	(3.341489)	(0.398625)	(0.380744)	(1.071659)	(0.90564)	(0.597012)	
R-squared	0.0519	0.0804	0.1381	0.0459	0.1152	0.2088	0.1784	0.1544	0.4124	0.1643	0.1302	
Number of households	443	443	443	443	443	443	443	443	443	443	443	

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Majorsex equals zero if HH has 2 female decision makers; Bangkok dummy equals zero; Urban dummy equals zero

Table 12. QUAIDS Engel curve for households with three decision makers (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco
Constant	24.46465	67.7485*	-6.441724	-10.31175	7.236299	-429.9641	25.23095	22.68928	323.8149***	-90.03241	-24.11504
	(73.03721)	(40.94513)	(33.23029)	(13.55906)	(9.420459)	(265.9891)	(29.82181)	(27.95234)	(84.08979)	(66.31179)	(43.48707)
Household size	-1.143744*	0.694353*	-0.271353	0.190553	0.049508	-5.765154**	1.379494***	-0.36747	1.058989	-0.756266	-0.168315
	(0.685763)	(0.384443)	(0.312007)	(0.127309)	(0.088451)	(2.497433)	(0.280004)	(0.262451)	(0.789538)	(0.622617)	(0.40831)
Young children	1.046486	-0.579179	-0.292508	-0.306296	-0.221566*	6.013984	-1.444409***	0.410258	2.515144**	-0.000749	-0.429777
	(1.028932)	(0.576826)	(0.468141)	(0.191017)	(0.132713)	(3.747195)	(0.420123)	(0.393786)	(1.184638)	(0.934186)	(0.612636)
Older children	0.058768	-0.32473	-0.26591	-0.21861	-0.072813	-0.364028	-0.110205	0.00337	0.163546	1.021278	-0.181924
	(0.854968)	(0.479301)	(0.388991)	(0.158721)	(0.110275)	(3.11365)	(0.349092)	(0.327208)	(0.984349)	(0.776241)	(0.509057)
Home owner	1.383509	0.694469	-1.250318**	0.134773	0.207705	-1.117826	-0.557993	-0.063333	1.361329	-1.103777	-0.968657
	(1.107285)	(0.620751)	(0.50379)	(0.205563)	(0.142819)	(4.032545)	(0.452115)	(0.423773)	(1.274848)	(1.005324)	(0.659288)
Vehicle owner	-1.015732	-0.070183	-0.167987	-0.125408	-0.084088	11.02385**	0.137202	0.865393*	-1.333248	0.367583	-0.163971
	(1.366062)	(0.765823)	(0.621527)	(0.253604)	(0.176197)	(4.974965)	(0.557776)	(0.52281)	(1.572785)	(1.240272)	(0.813366)
Husband age	0.109607	0.043951	0.006897	0.003881	0.012722	-0.124083	0.025834	-0.009248	0.078679	-0.106333	-0.123704**
	(0.083171)	(0.046626)	(0.037841)	(0.01544)	(0.010728)	(0.302894)	(0.03396)	(0.031831)	(0.095757)	(0.075512)	(0.049521)
Wife age	-0.060527	-0.028627	0.020217	0.002216	-0.022384*	-0.068125	-0.011886	0.015273	0.07665	-0.112307	0.085287
	(0.090446)	(0.050705)	(0.041151)	(0.016791)	(0.011666)	(0.32939)	(0.03693)	(0.034615)	(0.104133)	(0.082118)	(0.053853)
Third member's age	-0.022467	0.003013	0.004202	-0.000147	-0.002497	0.002905	0.020693	-0.010584	0.10549**	-0.091478**	-0.017565
	(0.043765)	(0.024535)	(0.019912)	(0.008125)	(0.005645)	(0.159385)	(0.01787)	(0.01675)	(0.050388)	(0.039735)	(0.026058)
Husband education (year)	0.184458	0.071589	0.103123	0.00007	-0.024107	0.13718	0.00896	0.050496	-0.298634	-0.18397	-0.118965
	(0.166624)	(0.093411)	(0.07581)	(0.030933)	(0.021492)	(0.606817)	(0.068034)	(0.063769)	(0.191839)	(0.151281)	(0.09921)
Wife education (year)	-0.046772	0.145825	-0.028263	0.04913	0.031281	-0.621107	-0.06382	0.13514**	0.291572	-0.062463	-0.190509*
	(0.176241)	(0.098802)	(0.080186)	(0.032718)	(0.022732)	(0.64184)	(0.071961)	(0.06745)	(0.202911)	(0.160012)	(0.104936)
Third member's education (year)	-0.211819	-0.121485	-0.075652	0.01296	0.007957	0.391349	0.172409***	0.008322	0.224829	-0.062749	-0.11037
	(0.161928)	(0.090778)	(0.073674)	(0.030061)	(0.020886)	(0.589714)	(0.066117)	(0.061972)	(0.186432)	(0.147017)	(0.096414)
Log (husband wages)	0.279515	0.969276*	-0.500727	-0.002587	-0.180671	10.08253***	0.490942	-0.17533	-0.664995	-0.489312	-0.88029
	(1.048504)	(0.587798)	(0.477046)	(0.19465)	(0.135238)	(3.818473)	(0.428114)	(0.401277)	(1.207172)	(0.951955)	(0.624289)
Log (wife wages)	-1.86566	-0.307408	-0.569818	-0.027971	0.289214	-11.1828**	0.72079	-0.557664	-0.322825	0.642367	0.789576
	(1.481926)	(0.830777)	(0.674243)	(0.275113)	(0.191141)	(5.396923)	(0.605085)	(0.567153)	(1.706183)	(1.345467)	(0.882353)
Log (third member's wages)	1.460101	0.365404	0.576299	-0.012343	0.168122	-0.004359	-0.263868	-0.445978	-1.560833	1.121958	-0.610834
	(1.030135)	(0.5775)	(0.468688)	(0.19124)	(0.132869)	(3.751577)	(0.420614)	(0.394247)	(1.186023)	(0.935278)	(0.613352)
Majorsex	0.357338	-0.204006	-0.684348*	-0.031934	-0.39685***	3.889298	-0.280387	-0.11454	-0.665625	-0.171376	1.602546***
	(0.891566)	(0.499818)	(0.405643)	(0.165516)	(0.114996)	(3.246934)	(0.364035)	(0.341215)	(1.026485)	(0.809469)	(0.530847)
Log (household total consumption)	-4.788647	-24.47855	0.662183	5.907702	-2.764929	152.348	-12.17825	-9.079334	-101.2847***	46.39831*	11.44747
	(28.15074)	(15.78149)	(12.80795)	(5.226069)	(3.630929)	(102.5202)	(11.49422)	(10.77367)	(32.41074)	(25.55856)	(16.76123)
Log (hh total consumption) square	0.779657	2.147812	0.307466	-0.66516	0.259658	-11.42531	1.049132	1.132339	8.184243***	-4.46902*	-0.818742
	(2.638681)	(1.479262)	(1.200541)	(0.48986)	(0.340341)	(9.609629)	(1.077399)	(1.009859)	(3.037987)	(2.395706)	(1.571096)
Central	-0.834184	0.248545	2.327942***	-0.418747	-0.137083	6.292008	-0.611237	1.405817**	1.659251	-3.606417**	2.001879**
	(1.586198)	(0.889233)	(0.721684)	(0.294471)	(0.20459)	(5.776663)	(0.64766)	(0.60706)	(1.826234)	(1.440137)	(0.944438)
North	-1.509964	-0.634799	4.070011***	-0.486788	-0.054723	19.02742***	0.320082	1.092538	0.568466	-5.206189***	2.128622*
	(1.98983)	(1.115512)	(0.905328)	(0.369404)	(0.256652)	(7.246625)	(0.812467)	(0.761535)	(2.290948)	(1.806603)	(1.184764)
Northeast	-1.317691	0.581819	3.69421***	-0.555856	0.149703	18.02577**	-1.165729	0.387882	2.624745	-4.619977**	2.275868*
	(2.224964)	(1.247329)	(1.012309)	(0.413056)	(0.28698)	(8.102944)	(0.908475)	(0.851524)	(2.561664)	(2.020085)	(1.324766)
South	0.651387	2.463837**	2.813652***	-0.941498**	-0.108555	8.053331	-1.214759	0.16361	2.733987	-4.443074**	0.352269
	(2.128017)	(1.19298)	(0.9682)	(0.395058)	(0.274475)	(7.749879)	(0.868891)	(0.814421)	(2.450046)	(1.932065)	(1.267042)
Rural	1.043096	-0.486622	0.380848	-0.004986	0.007405	2.854497	0.152609	-0.082899	-2.103377*	-0.725852	0.225456
	(1.026453)	(0.575436)	(0.467013)	(0.190557)	(0.132394)	(3.738167)	(0.419111)	(0.392837)	(1.181784)	(0.931935)	(0.61116)
R-squared	0.0478	0.0593	0.0971	0.0357	0.0854	0.0536	0.1320	0.1397	0.3170	0.1542	0.1289
Number of households	443	443	443	443	443	443	443	443	443	443	443

[1] Standard error in parentheses

[2] *** Significant at 1%
** Significant at 5%
* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Majorsex equals zero if the household has two female decision makers; Bangkok dummy equals zero; Urban dummy equals zero

Table 13. Test of Pareto efficiency using different base categories

Category	Engel curve (2.22)	Engel curve (2.22) 3SLS
1. Housing	4.51	5.14
2. Household operations	3.83	4.88
3. Clothing & Footwear	6.67	4.70
4. Personal & Services	4.13	0.90
5. Cosmetic	2.80	1.91
6. Transportation & Communication	3.25	0.00
7. Education	4.51	2.77
8. Recreation & Religion	4.28	6.00
9. Food eaten at home	6.08	5.30
10. Food eaten outside	5.89	7.14
11. Alcohol & Tobacco	1.66	1.61

[1] ** Critical chi-square (18) at 5% is 28.8693

Table 14. Descriptive statistics for all subsamples

Variable	Single female		Single male		Married couple	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Log household total expenditure	9.013	0.529	8.913	0.532	9.317	0.486
Female age (less 35)	2.289	11.753			-0.918	10.580
Female years of education (less 9)	3.181	5.031			1.118	4.517
Female's income share (less 0.45)					0.010	0.095
Male age (less 35)			0.339	11.267	1.323	11.011
Male years of education (less 9)			1.709	4.633	1.151	4.461
Budget shares on:						
Housing	0.215	0.095	0.202	0.086	0.163	0.076
Household operations	0.067	0.047	0.057	0.036	0.066	0.035
Clothing & Footwear	0.064	0.070	0.040	0.053	0.038	0.046
Personal & Services	0.045	0.032	0.029	0.020	0.035	0.021
Cosmetic	0.018	0.032	0.003	0.010	0.008	0.015
Transportation & Communication	0.162	0.094	0.161	0.102	0.191	0.096
Recreation & Religion	0.024	0.032	0.017	0.024	0.019	0.025
Food eaten at home	0.257	0.125	0.236	0.136	0.275	0.109
Food eaten outside	0.122	0.098	0.154	0.121	0.139	0.096
Alcohol & Tobacco	0.009	0.041	0.093	0.107	0.052	0.066
Health	0.016	0.051	0.008	0.034	0.014	0.035
Number of observations	810		825		1108	

Table 15. Estimation results

Variable	Model A	Model B	Model C	Model D
$d_{0,f}$	-0.133	-0.168	0.875	0.509
	(0.333)	(0.344)	(0.932)	(0.705)
$d_{0,m}$	0.618	0.569	82.44	104.116
	(0.604)	(0.599)	(240.241)	(383.430)
$d_{age,f}$	-0.074***	-0.071***	0.004	-0.009
	(0.021)	(0.02)	(0.019)	(0.013)
$d_{age,m}$	-0.013	-0.011	0.207	0.162
	(0.019)	(0.018)	(0.306)	(0.445)
$d_{educ,f}$	0.047	0.044	-0.022	0.019
	(0.036)	(0.036)	(0.056)	(0.039)
$d_{educ,m}$	0.007	0.01	-0.038	0.237
	(0.034)	(0.034)	(0.69)	(0.919)
r_0	0.649***	0.591**	0.355***	0.263
	(0.054)	(0.259)	(0.125)	(0.575)
$r_{f,\ inc\ share}$	0.012	0.053	0.006	0.592
	(0.009)	(0.042)	(0.042)	(1.076)
$r_{age,f}$	-0.005***	-0.013***	0.001	-0.01
	(0.001)	(0.004)	(0.004)	(0.021)
$r_{age,m}$	-0.003**	-0.013***	-0.0003	0.004
	(0.001)	(0.004)	(0.003)	(0.013)
$r_{educ,f}$	0.003*	0.012*	-0.002	0.011
	(0.002)	(0.006)	(0.005)	(0.043)
$r_{educ,m}$	-0.001	-0.005	0.001	0.006
	(0.001)	(0.004)	(0.006)	(0.039)
Form of the sharing rule (η)	Linear	Logistic	Linear	Logistic
Instrument log expenditure (x)	No	No	Yes	Yes
Number of observations	2743	2743	2743	2743

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

APPENDIX A: ESTIMATES OF THE QUASI-QUADRATIC ENGEL CURVE

Appendix A 1. Quasi-quadratic Engel curve (1.16) for households with spouses only

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	4.62882	1.247133	-2.537561	2.160066***	0.078832	-2.763209**	-3.037111	0.135442	-0.574997	15.93033***	19.18081***	4.486884**	
	(4.088519)	(0.913843)	(1.487438)	(0.699381)	(0.450759)	(1.379431)	(3.043871)	(0.501868)	(0.906372)	(2.485461)	(2.474664)	(1.873181)	
Home owner	10.0788***	2.142745***	0.967383	0.481539	0.592589***	0.250951	4.532964***	0.206104	0.562016	1.932907*	1.269151	-2.257723***	0.3096
	(1.808474)	(0.40422)	(0.657938)	(0.309357)	(0.199384)	(0.610163)	(1.346395)	(0.221991)	(0.400915)	(1.099394)	(1.094618)	(0.828564)	
Vehicle owner	0.230099	0.614632	0.293274	-0.033724	-0.000328	0.011667	3.508602***	-0.032107	0.395226	-0.155497	-0.367166	1.409723*	0.7238
	(1.697436)	(0.379401)	(0.617542)	(0.290363)	(0.187142)	(0.5727)	(1.263728)	(0.208361)	(0.3763)	(1.031892)	(1.027409)	(0.777691)	
Husband age	-0.050962	0.005415	-0.005317	-0.015459	-0.017024	0.043476	-0.031043	0.006206	0.002006	0.082051	-0.122008	-0.03146	36.3231
	(0.151079)	(0.033768)	(0.054964)	(0.025844)	(0.016657)	(0.050973)	(0.112477)	(0.018545)	(0.033492)	(0.091843)	(0.091444)	(0.069218)	
Wife age	-0.046326	0.044293	-0.052078	-0.034487	-0.013123	0.0113	-0.156963	-0.011943	-0.030662	-0.032188	-0.16764*	0.014049	34.0821
	(0.157754)	(0.03526)	(0.057392)	(0.026985)	(0.017392)	(0.053225)	(0.117447)	(0.019364)	(0.034972)	(0.095901)	(0.095484)	(0.072276)	
Husband education (year)	0.220267	-0.013079	0.108879	0.03837	0.032824	-0.060724	0.468239**	0.010033	0.025678	0.150667	-0.096899	-0.235446**	10.1507
	(0.262564)	(0.058687)	(0.095523)	(0.044914)	(0.028948)	(0.088587)	(0.195477)	(0.03223)	(0.058207)	(0.159616)	(0.158923)	(0.120295)	
Wife education (year)	0.019666	0.262652***	0.048434	0.055358	0.027181	0.104756	0.208639	-0.008886	0.07038	0.182743	0.20743	0.075192	10.1182
	(0.275903)	(0.061668)	(0.100376)	(0.047196)	(0.030418)	(0.093087)	(0.205408)	(0.033867)	(0.061164)	(0.167725)	(0.166996)	(0.126407)	
Husband wage&salary	-5.54442***	1.034597***	0.192031	0.72442***	0.005832	-1.172225***	0.847019	-0.203449	0.720248***	-0.523367	0.455812	0.056368	106.4901
	(1.21678)	(0.271968)	(0.442675)	(0.208142)	(0.13415)	(0.410531)	(0.905884)	(0.149361)	(0.269745)	(0.739696)	(0.736482)	(0.557476)	
Wife wage&salary	-5.483625***	1.015906***	0.253939	0.744399***	0.014047	-1.091012***	0.902168	-0.206046	0.718153***	-0.571215	0.526612	0.053456	91.2456
	(1.218265)	(0.2723)	(0.443215)	(0.208396)	(0.134314)	(0.411032)	(0.906989)	(0.149543)	(0.270074)	(0.740598)	(0.737381)	(0.558156)	
HH total income	5.627628***	-1.012345***	-0.179889	-0.71272***	0.000173	1.153366***	-0.700299	0.204182	-0.70312***	0.603602	-0.427403	-0.034349	198.0402
	(1.217237)	(0.27207)	(0.442841)	(0.20822)	(0.134201)	(0.410685)	(0.906224)	(0.149417)	(0.269846)	(0.739974)	(0.736759)	(0.557685)	
Husband w&s square	0.001994*	-0.001517***	-0.000942**	-0.000863***	0.000039	0.000198	-0.001206	0.000191	-0.000892***	-0.000271	-0.0003	-0.000451	19347.2200
	(0.001109)	(0.000248)	(0.000403)	(0.00019)	(0.000122)	(0.000374)	(0.000825)	(0.000136)	(0.000246)	(0.000674)	(0.000671)	(0.000508)	
Wife w&s square	0.00191*	-0.001536***	-0.001164***	-0.000932***	0.000011	-0.000011	-0.001433*	0.000194	-0.000909***	-0.000288	-0.00043	-0.000469	14730.5500
	(0.001126)	(0.000252)	(0.00041)	(0.000193)	(0.000124)	(0.00038)	(0.000838)	(0.000138)	(0.00025)	(0.000685)	(0.000682)	(0.000516)	
HH total income square	-0.002155*	0.001499***	0.000902**	0.000854***	-0.000052	-0.000136	0.001085	-0.000202	0.000882***	0.000122	0.000377	0.000566	65380.3400
	(0.00111)	(0.000248)	(0.000404)	(0.00019)	(0.000122)	(0.000375)	(0.000826)	(0.000136)	(0.000246)	(0.000675)	(0.000672)	(0.000509)	
Husws * Wifews	0.004394**	-0.002976***	-0.001602**	-0.001688***	0.000128	0.000271	-0.002162	0.000436	-0.001749***	-0.000093	-0.000972	-0.001414	15541.3800
	(0.002234)	(0.000499)	(0.000813)	(0.000382)	(0.000246)	(0.000754)	(0.001663)	(0.000274)	(0.000495)	(0.001358)	(0.001352)	(0.001023)	
Central	-3.184762	-0.207101	1.80237**	0.034839	-0.002288	-0.186018	-0.119464	0.056899	0.525967	1.851735	-0.974362	0.510734	0.5135
	(2.021973)	(0.45194)	(0.735611)	(0.345878)	(0.222923)	(0.682196)	(1.505344)	(0.248199)	(0.448246)	(1.229183)	(1.223843)	(0.92638)	
North	-2.964756	-1.981679***	2.520144**	-0.081597	0.077772	0.119965	-4.368114**	0.010833	0.625273	-1.849128	-6.783083***	0.055843	0.1119
	(2.813279)	(0.628809)	(1.023495)	(0.481239)	(0.310164)	(0.949176)	(2.094465)	(0.345332)	(0.623668)	(1.710227)	(1.702798)	(1.288922)	
Northeast	-11.11628***	-1.976974***	0.479287	-0.718239	-0.218553	-2.134999**	-2.885923	0.425987	-0.658347	-1.425639	-10.39079***	0.746323	0.1092
	(2.894822)	(0.647035)	(1.053161)	(0.495188)	(0.319154)	(0.976687)	(2.155173)	(0.355341)	(0.641745)	(1.759798)	(1.752153)	(1.326281)	
South	-6.160014**	-1.927251***	0.206349	-0.2706	-0.010133	-0.942858	-5.803028***	-0.040809	-0.299242	1.503657	-1.449722	-0.099398	0.0930
	(2.880711)	(0.643881)	(1.048027)	(0.492774)	(0.317599)	(0.971927)	(2.144667)	(0.353609)	(0.638617)	(1.75122)	(1.743612)	(1.319816)	
Rural	0.660931	-0.378032	0.553346	-0.133006	-0.006646	-0.677087	0.393143	-0.1454	-0.58247	-0.736201	-2.295132**	0.408466	0.2527
	(1.616781)	(0.361374)	(0.588199)	(0.276566)	(0.17825)	(0.545488)	(1.203681)	(0.198461)	(0.35842)	(0.982861)	(0.978591)	(0.740738)	
R-squared	0.2859	0.3237	0.3116	0.2356	0.1554	0.1391	0.5569	0.0162	0.2212	0.1889	0.1631	0.0559	
Number of households	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108

1 Standard error in parentheses

2 *** Significant at 1%

** Significant at 5%

* Significant at 10%

3 Incomes in 100 baht

4 Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix A 2. Quasi-quadratic Engel curve (1.16) for spouses with kids, no others

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	7.691888**	-4.626713*	-8.703235***	7.32846***	-2.143228**	1.187164	-7.39408	-7.307036***	-2.39929	8.815167*	7.301019**	2.654427	
	(3.586904)	(2.748746)	(2.520889)	(2.594281)	(0.98068)	(1.76549)	(4.922307)	(1.809558)	(1.467492)	(4.841619)	(3.406892)	(3.071063)	
Household size	0.080032	1.484869***	0.984512**	0.016145	0.310981*	0.393227	0.320696	1.60073***	-0.396108	4.363924***	0.822891	-0.01304	3.4874
	(0.645139)	(0.494388)	(0.453406)	(0.466606)	(0.176385)	(0.317541)	(0.885324)	(0.325467)	(0.263943)	(0.870812)	(0.612762)	(0.55236)	
Home owner	7.499744***	0.617768	0.482058	-0.703994	0.035961	-0.038494	2.074347*	0.829848*	0.299218	-0.579721	1.112403	-1.111496	0.5549
	(0.848888)	(0.650527)	(0.596602)	(0.613971)	(0.232091)	(0.417827)	(1.164929)	(0.428256)	(0.347302)	(1.145833)	(0.806286)	(0.726808)	
Vehicle owner	-0.400681	0.477627	0.455171	-0.072206	0.269659	-0.758246	5.515184***	1.326755*	0.652318	1.28244	-0.321366	1.110315	0.8948
	(1.419808)	(1.088039)	(0.997846)	(1.026897)	(0.388183)	(0.698836)	(1.948401)	(0.716279)	(0.580879)	(1.916462)	(1.348553)	(1.215622)	
Husband age	0.000151	0.045246	-0.017793	0.001992	-0.01497	-0.006949	-0.097746	-0.047299	0.012501	-0.08981	-0.028042	-0.074583	38.2932
	(0.092334)	(0.070758)	(0.064892)	(0.066782)	(0.025245)	(0.045447)	(0.126709)	(0.046581)	(0.037776)	(0.124632)	(0.0877)	(0.079055)	
Wife age	0.034356	0.042611	0.026722	-0.143858**	0.042794	-0.041842	0.239767*	0.121881**	0.035243	0.127429	0.037567	0.064413	35.7113
	(0.096544)	(0.073985)	(0.067852)	(0.069827)	(0.026396)	(0.04752)	(0.132488)	(0.048706)	(0.039499)	(0.130316)	(0.091699)	(0.08266)	
Husband education (year)	0.484108***	0.289727**	0.296528***	0.179473	0.070764*	-0.022573	0.786652***	0.056432	0.109331*	0.366467*	-0.007541	0.049295	10.6124
	(0.153259)	(0.117446)	(0.107711)	(0.110847)	(0.041902)	(0.075435)	(0.210317)	(0.077318)	(0.062702)	(0.206869)	(0.145567)	(0.131218)	
Wife education (year)	0.456027***	0.079908	0.147061	0.210725*	0.116475***	0.06344	0.611136***	0.065437	-0.065122	0.366049*	0.347446**	-0.160789	10.6484
	(0.152833)	(0.11712)	(0.107412)	(0.110539)	(0.041785)	(0.075225)	(0.209733)	(0.077103)	(0.062528)	(0.206295)	(0.145163)	(0.130854)	
Husband wage&salary	-0.475442	-0.023415	-0.303279	-0.26659	0.688972***	-0.128178	2.644928**	0.328308	-0.444734	-0.184228	-0.09051	0.796149	120.7648
	(0.766374)	(0.587294)	(0.538611)	(0.554291)	(0.209531)	(0.377213)	(1.051695)	(0.386628)	(0.313543)	(1.034455)	(0.727913)	(0.65616)	
Wife wage&salary	-0.497451	-0.008496	-0.304678	-0.212811	0.718934***	-0.109096	2.801446***	0.376691	-0.442125	-0.114889	-0.110296	0.762359	94.0006
	(0.764718)	(0.586025)	(0.537446)	(0.553093)	(0.209078)	(0.376398)	(1.049422)	(0.385793)	(0.312865)	(1.032219)	(0.72634)	(0.654742)	
HH total income	0.515666	0.032184	0.327365	0.250126	-0.709467***	0.133655	-2.624931**	-0.327535	0.463103	0.215058	0.131345	-0.764777	215.1794
	(0.767021)	(0.58779)	(0.539065)	(0.554759)	(0.209708)	(0.377531)	(1.052582)	(0.386955)	(0.313807)	(1.035328)	(0.728527)	(0.656714)	
Husband w&s square	-0.000347	-0.000098	0.000376	0.000721	-0.00179***	0.000147	-0.006115***	-0.000852	0.0005	-0.000425	0.000313	-0.001985*	27315.6700
	(0.001267)	(0.000971)	(0.000891)	(0.000916)	(0.000346)	(0.000624)	(0.001739)	(0.000639)	(0.000518)	(0.00171)	(0.001204)	(0.001085)	
Wife w&s square	-0.000364	-0.000172	0.00032	0.000616	-0.001844***	0.000133	-0.006457***	-0.000965	0.000477	-0.000553	0.000311	-0.001914*	15772.2400
	(0.001265)	(0.000969)	(0.000889)	(0.000915)	(0.000346)	(0.000622)	(0.001735)	(0.000638)	(0.000517)	(0.001707)	(0.001201)	(0.001083)	
HH total income square	0.000374	0.000144	-0.000323	-0.000588	0.001838***	-0.000151	0.006365***	0.000935	-0.000495	0.000458	-0.000357	0.001957*	80401.1900
	(0.001267)	(0.000971)	(0.00089)	(0.000916)	(0.000346)	(0.000624)	(0.001738)	(0.000639)	(0.000518)	(0.00171)	(0.001203)	(0.001085)	
Husws * Wifews	-0.000782	-0.000315	0.000549	0.001042	-0.003684***	0.000304	-0.012975***	-0.001996	0.000985	-0.000982	0.000814	-0.003906*	18561.0400
	(0.002533)	(0.001941)	(0.00178)	(0.001832)	(0.000693)	(0.001247)	(0.003476)	(0.001278)	(0.001036)	(0.003419)	(0.002406)	(0.002169)	
Central	-6.183872***	-0.502631	3.156497***	-1.436743	-0.109652	-0.47322	-5.864779***	-2.794723***	1.023269*	-0.86342	-3.2225**	2.048446	0.3786
	(1.467896)	(1.12489)	(1.031642)	(1.061677)	(0.401331)	(0.722505)	(2.014392)	(0.740539)	(0.600553)	(1.981372)	(1.394228)	(1.256794)	
North	-11.54594***	-1.426455	3.795213***	-2.851792**	0.119571	-0.76614	-13.13101***	-3.163742***	-0.288008	-5.205621**	-7.201807***	1.011391	0.1871
	(1.600255)	(1.22632)	(1.124665)	(1.157408)	(0.437519)	(0.787653)	(2.196029)	(0.807313)	(0.654704)	(2.160031)	(1.519945)	(1.370118)	
Northeast	-11.95611***	-3.037681**	0.323659	-1.601839	-0.417711	-0.902461	-13.34559***	-5.756561***	-0.350994	-1.916061	-7.547603***	1.138169	0.1691
	(1.642136)	(1.258415)	(1.154099)	(1.187699)	(0.448969)	(0.808267)	(2.253503)	(0.828442)	(0.671839)	(2.216563)	(1.559724)	(1.405977)	
South	-7.172112***	-2.075567	3.281955***	-2.14349*	-0.328647	-0.719748	-9.184138***	-3.641218***	-0.55694	-0.713927	-5.052498***	0.402985	0.1538
	(1.675848)	(1.28425)	(1.177792)	(1.212082)	(0.458186)	(0.82486)	(2.299765)	(0.845449)	(0.685631)	(2.262067)	(1.591744)	(1.43484)	
Rural	-2.450314**	-0.583092	-1.555412**	0.300532	-0.199507	-0.044887	1.394296	-0.681064	-0.226868	-0.499155	-0.791305	0.568796	0.2590
	(1.006615)	(0.771398)	(0.707453)	(0.728049)	(0.275214)	(0.495461)	(1.381378)	(0.507828)	(0.411832)	(1.358734)	(0.956097)	(0.861851)	
R-squared	0.4573	0.3096	0.2944	0.5491	0.6105	0.0705	0.7334	0.4019	0.3016	0.2842	0.2526	0.0626	
Number of households	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112

1 Standard error in parentheses

2 *** Significant at 1%

** Significant at 5%

* Significant at 10%

3 Incomes in 100 baht

4 Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix A 3. Quasi-quadratic Engel curve (1.16) for spouses with others, no kids

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	33.36615*	1.715238	-6.277159	-8.968699	1.854225	-0.39126	1.36197	2.197409	-3.904654	3.633912	5.941415	5.196893	
	(19.00924)	(6.371599)	(6.722842)	(8.236811)	(2.109771)	(13.50095)	(16.14645)	(11.02351)	(5.568071)	(11.41343)	(10.29174)	(6.3392)	
Household size	6.059839**	2.502931***	0.688474	3.407483***	-0.317755	0.208508	4.453686*	2.78513*	1.087083	5.69608***	3.662724**	0.816366	3.4076
	(2.768981)	(0.928119)	(0.979283)	(1.199815)	(0.30732)	(1.966615)	(2.351972)	(1.605739)	(0.811073)	(1.662537)	(1.499146)	(0.923399)	
Home owner	10.61327**	0.49266	-0.348317	0.963357	0.906732*	-0.454034	1.676493	1.994892	0.022927	2.886268	3.5134	2.141459	0.7994
	(4.911224)	(1.646165)	(1.736912)	(2.128061)	(0.54508)	(3.488102)	(4.171593)	(2.848031)	(1.438566)	(2.948772)	(2.658972)	(1.637794)	
Vehicle owner	13.18326*	2.694344	-1.423792	1.695636	-1.546157**	-8.360764*	16.10571***	0.629188	2.862677	-0.596022	-3.071252	-2.482115	0.9204
	(7.022037)	(2.353676)	(2.483426)	(3.042688)	(0.779352)	(4.987266)	(5.964517)	(4.072097)	(2.056852)	(4.216137)	(3.801781)	(2.341708)	
Husband age	-0.360524	0.043045	-0.010746	0.047172	-0.032255	-0.214487	0.173711	-0.191448	-0.043204	-0.157686	0.063293	-0.21111	47.3567
	(0.420478)	(0.140938)	(0.148707)	(0.182196)	(0.046667)	(0.298636)	(0.357154)	(0.243836)	(0.123164)	(0.252461)	(0.22765)	(0.140221)	
Wife age	0.098073	0.00408	0.025864	0.009058	0.034147	0.363357	-0.55448	0.120803	0.111073	0.35043	0.095527	0.128293	45.2580
	(0.45895)	(0.153833)	(0.162313)	(0.198866)	(0.050937)	(0.32596)	(0.389832)	(0.266146)	(0.134433)	(0.27556)	(0.248479)	(0.153051)	
Husband education (year)	0.864348	0.075319	-0.008755	0.171701	-0.110083	-0.267755	1.337227**	0.48258	0.112312	-0.001353	0.306063	-0.567663**	11.9841
	(0.782817)	(0.262388)	(0.276853)	(0.339199)	(0.086882)	(0.555981)	(0.664925)	(0.453958)	(0.229298)	(0.470015)	(0.423823)	(0.261054)	
Wife education (year)	-0.369397	0.46823*	0.25621	0.376496	0.211575**	0.570724	-0.442647	-1.007999**	-0.037196	0.691844	0.785382*	0.135337	11.9172
	(0.777567)	(0.260628)	(0.274996)	(0.336924)	(0.0863)	(0.552252)	(0.660465)	(0.450913)	(0.22776)	(0.466863)	(0.42098)	(0.259303)	
Husband wage&salary	0.575624	0.676005	-0.014904	0.438789	0.241276	1.683641	-1.933038	-1.3482	0.710242	-0.46249	1.840081	-0.644816	191.8114
	(2.260407)	(0.757653)	(0.79942)	(0.979447)	(0.250875)	(1.60541)	(1.919989)	(1.310816)	(0.662105)	(1.357182)	(1.223801)	(0.7538)	
Wife wage&salary	0.64198	0.651544	-0.027093	0.388424	0.228709	1.635491	-1.852569	-1.328079	0.765342	-0.540946	1.826565	-0.713706	163.1361
	(2.260559)	(0.757704)	(0.799473)	(0.979513)	(0.250892)	(1.605518)	(1.920119)	(1.310904)	(0.662149)	(1.357274)	(1.223883)	(0.753851)	
HH total income	-0.543983	-0.660312	0.029476	-0.428294	-0.235837	-1.638658	2.009745	1.383006	-0.716977	0.536874	-1.858671	0.702034	355.5988
	(2.268872)	(0.76049)	(0.802413)	(0.983115)	(0.251814)	(1.611422)	(1.927179)	(1.315724)	(0.664584)	(1.362265)	(1.228384)	(0.756623)	
Husband w&s square	-0.001368	-0.0009	-0.00018	-0.000885	-0.000243	-0.001754	0.001822	0.002214	-0.001162	0.000496	-0.002509*	0.000501	55216.0200
	(0.002557)	(0.000857)	(0.000904)	(0.001108)	(0.000284)	(0.001816)	(0.002172)	(0.001483)	(0.000749)	(0.001535)	(0.001384)	(0.000853)	
Wife w&s square	-0.001343	-0.000879	-0.000163	-0.000852	-0.000232	-0.001736	0.001746	0.002171	-0.001209	0.000569	-0.002535*	0.000554	44616.7100
	(0.002562)	(0.000859)	(0.000906)	(0.00111)	(0.000284)	(0.00182)	(0.002177)	(0.001486)	(0.000751)	(0.001539)	(0.001387)	(0.000855)	
HH total income square	0.001462	0.000876	0.000132	0.000834	0.00023	0.001758	-0.001703	-0.002103	0.001177	-0.000576	0.00254*	-0.000528	187229.3000
	(0.002563)	(0.000859)	(0.000907)	(0.001111)	(0.000285)	(0.001821)	(0.002177)	(0.001486)	(0.000751)	(0.001539)	(0.001388)	(0.000855)	
Husws * Wifews	-0.003274	-0.001654	-0.000099	-0.001493	-0.000424	-0.003571	0.003188	0.003975	-0.002369	0.001215	-0.004996*	0.000988	43458.9400
	(0.005116)	(0.001715)	(0.001809)	(0.002217)	(0.000568)	(0.003634)	(0.004346)	(0.002967)	(0.001499)	(0.003072)	(0.00277)	(0.001706)	
Central	-49.31369***	-8.406606***	5.939495**	-4.608381	-0.046428	-1.9271	-7.049457	-8.246009**	-4.469431**	-5.298473	-7.103836***	2.519388	0.3854
	(7.05226)	(2.363806)	(2.494114)	(3.055783)	(0.782706)	(5.008731)	(5.990188)	(4.089623)	(2.065705)	(4.234282)	(3.818144)	(2.351787)	
North	-58.57742***	-9.835184***	3.961612	-7.147047**	-0.275825	0.86922	-21.3503***	-6.878152	-6.382251***	-5.281836	-14.07595***	0.302582	0.2038
	(7.704572)	(2.582451)	(2.724812)	(3.338434)	(0.855104)	(5.472023)	(6.544262)	(4.4679)	(2.256776)	(4.625941)	(4.171311)	(2.56932)	
Northeast	-62.81195***	-14.33616***	5.204489*	-8.571843***	0.502297	-5.61215	-22.86777***	-13.30127***	-7.852556***	-9.973121**	-20.80429***	2.835588	0.2420
	(7.595056)	(2.545743)	(2.686081)	(3.29098)	(0.842949)	(5.394241)	(6.451239)	(4.404392)	(2.224697)	(4.560185)	(4.112018)	(2.532798)	
South	-52.05416***	-10.824***	8.838409***	-6.699421*	0.415143	1.337717	-16.60449**	-3.206557	-5.766239**	-5.157351	-11.95407**	4.708121	0.0828
	(9.211614)	(3.087588)	(3.257796)	(3.991444)	(1.022366)	(6.542371)	(7.824344)	(5.341838)	(2.69821)	(5.530791)	(4.987234)	(3.071888)	
Rural	-1.977252	-2.248043	0.064967	-0.470691	0.008338	-0.974896	-5.413884	0.939791	-0.106269	-2.130401	-5.150929**	-0.351514	0.2293
	(4.632842)	(1.552856)	(1.638459)	(2.007436)	(0.514183)	(3.290387)	(3.935135)	(2.686597)	(1.357024)	(2.781628)	(2.508254)	(1.54496)	
R-squared	0.3900	0.4326	0.3184	0.1751	0.1910	0.0914	0.6055	0.2794	0.2301	0.2926	0.2637	0.0772	
Number of households	314	314	314	314	314	314	314	314	314	314	314	314	314

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix A 4. Quasi-quadratic Engel curve (1.16) for spouses with kids and others

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	8.048147	-0.95667	2.458862	4.751777	-0.157569	12.75868	3.407915	-6.378675	1.552706	15.00858	13.21995	4.468619	
	(12.38509)	(6.59724)	(7.382409)	(3.767399)	(1.498428)	(10.74838)	(12.13728)	(5.462524)	(3.02792)	(10.56571)	(8.65971)	(5.182062)	
Household size	0.757195	3.328155***	-1.245442	0.029404	0.092017	-0.257538	2.109321	0.792769	-0.302243	1.167153	-1.473088	0.09652	4.5639
	(2.311547)	(1.231305)	(1.377849)	(0.703145)	(0.279666)	(2.006072)	(2.265296)	(1.019523)	(0.565129)	(1.971979)	(1.616244)	(0.967177)	
Young children	3.37613	-1.942357	0.898784	0.831362	-0.392649	2.302906	-2.64439	-1.238937	0.282609	6.599321**	1.659504	0.068178	0.3333
	(3.559932)	(1.89629)	(2.121976)	(1.082889)	(0.430703)	(3.08948)	(3.488702)	(1.570131)	(0.870336)	(3.036976)	(2.48912)	(1.489515)	
Older children	-2.762861	-2.548151	3.072073*	-0.560838	-0.394971	2.128335	-1.125871	1.352081	0.407608	1.065931	4.009764**	-0.274582	1.0251
	(3.045576)	(1.622305)	(1.815383)	(0.926428)	(0.368473)	(2.643097)	(2.984637)	(1.343271)	(0.744585)	(2.598179)	(2.12948)	(1.274303)	
Home owner	5.097523*	0.764297	0.131241	0.547	0.226032	1.090195	4.097644	-0.570151	0.221677	-2.058077	2.180688	-1.361095	0.7820
	(2.661121)	(1.417515)	(1.58622)	(0.809482)	(0.321959)	(2.309449)	(2.607875)	(1.173704)	(0.650594)	(2.2702)	(1.860667)	(1.113443)	
Vehicle owner	4.20332	-0.975975	0.322009	0.757426	0.178889	4.361693	11.95592***	2.701529	1.336814	-1.736565	1.24858	0.652797	0.9223
	(4.255732)	(2.266926)	(2.536723)	(1.294543)	(0.514886)	(3.693329)	(4.17058)	(1.877018)	(1.040446)	(3.630562)	(2.975626)	(1.780646)	
Husband age	0.221082	-0.21439	-0.050035	-0.097698	0.002829	-0.210549	-0.338199	-0.008679	0.027576	-0.191183	-0.054246	-0.135452	42.3008
	(0.272977)	(0.145408)	(0.162714)	(0.083036)	(0.033027)	(0.236902)	(0.267515)	(0.120398)	(0.066738)	(0.232876)	(0.190867)	(0.114217)	
Wife age	-0.032494	0.12955	-0.028055	0.073116	-0.00589	-0.011623	0.058548	0.171518	-0.03667	0.372883	0.107752	0.147406	39.3158
	(0.275119)	(0.14655)	(0.163991)	(0.083688)	(0.033286)	(0.238762)	(0.269615)	(0.121343)	(0.067262)	(0.234704)	(0.192365)	(0.115113)	
Husband education (year)	0.58257	-0.016799	-0.05805	-0.05551	0.018881	0.178672	0.156794	0.087285	0.017274	0.195401	0.077881	-0.151997	11.1404
	(0.407488)	(0.217059)	(0.242892)	(0.123953)	(0.049301)	(0.353638)	(0.399335)	(0.179725)	(0.099623)	(0.347628)	(0.284917)	(0.170498)	
Wife education (year)	0.68194	0.081605	0.233532	0.123279	0.048611	0.126234	-0.057424	0.173628	-0.069326	0.531409	0.286661	0.054476	11.2682
	(0.415474)	(0.221313)	(0.247652)	(0.126382)	(0.050267)	(0.360568)	(0.40716)	(0.183247)	(0.101575)	(0.35444)	(0.290501)	(0.173839)	
Husband wage&salary	0.445058	-0.214153	-0.01742	0.228937	-0.059037	-0.723858	-3.686507***	0.36813	-0.745525**	-0.699431	1.182678	-0.075655	150.4377
	(1.331165)	(0.709079)	(0.79347)	(0.404925)	(0.161053)	(1.155249)	(1.30453)	(0.587119)	(0.325445)	(1.135616)	(0.930756)	(0.556974)	
Wife wage&salary	0.283716	-0.255091	-0.060157	0.18673	-0.08414	-0.691298	-3.765175***	0.347529	-0.744521**	-0.763958	1.106492	-0.103676	112.6142
	(1.334331)	(0.710766)	(0.795358)	(0.405888)	(0.161436)	(1.157997)	(1.307633)	(0.588515)	(0.326219)	(1.138317)	(0.93297)	(0.558299)	
HH total income	-0.349166	0.264144	0.065699	-0.196765	0.074823	0.73095	3.859327***	-0.350758	0.753095**	0.78608	-1.103856	0.095154	263.8561
	(1.329196)	(0.708031)	(0.792297)	(0.404326)	(0.160815)	(1.15354)	(1.3026)	(0.58625)	(0.324963)	(1.133936)	(0.929379)	(0.55615)	
Husband w&s square	-0.000227	0.000156	-0.000027	-0.00117***	0.000047	0.000301	0.001792*	-0.000453	0.000455*	0.000121	-0.000723	0.000073	35073.6800
	(0.001035)	(0.000551)	(0.000617)	(0.000315)	(0.000125)	(0.000898)	(0.001014)	(0.000457)	(0.000253)	(0.000883)	(0.000724)	(0.000433)	
Wife w&s square	0.000188	0.000185	0.000095	-0.001027***	0.00011	0.000344	0.001734*	-0.000395	0.000458*	0.000226	-0.0006	0.00002	20749.1300
	(0.001037)	(0.000553)	(0.000618)	(0.000316)	(0.000126)	(0.0009)	(0.001016)	(0.000457)	(0.000254)	(0.000885)	(0.000725)	(0.000434)	
HH total income square	0.000089	-0.000194	-0.000078	0.001136***	-0.000066	-0.000303	-0.001872*	0.000464	-0.000468*	-0.0002	0.00064	-0.000054	103858.2000
	(0.001033)	(0.00055)	(0.000616)	(0.000314)	(0.000125)	(0.000897)	(0.001012)	(0.000456)	(0.000253)	(0.000881)	(0.000722)	(0.000432)	
Husws * Wifews	-0.000072	0.000465	0.000282	-0.002338***	0.000115	0.00046	0.003929*	-0.000928	0.001012**	0.000391	-0.001257	0.0001	23679.7800
	(0.002093)	(0.001115)	(0.001248)	(0.000637)	(0.000253)	(0.001817)	(0.002052)	(0.000923)	(0.000512)	(0.001786)	(0.001464)	(0.000876)	
Central	-22.29841***	-2.087883	1.668737	-2.346411*	-0.656475	-11.83513***	-9.724456**	-5.398981***	0.228805	0.943944	-6.715775**	-0.018903	0.3784
	(4.383741)	(2.335113)	(2.613026)	(1.333482)	(0.530373)	(3.804421)	(4.296027)	(1.933477)	(1.071741)	(3.739766)	(3.06513)	(1.834206)	
North	-24.71957***	-0.669343	1.891174	-1.509163	-0.376887	-14.55538***	-16.13729***	-5.737996***	-1.224165	0.419934	-12.50724***	0.181933	0.1779
	(4.681985)	(2.49398)	(2.790801)	(1.424205)	(0.566457)	(4.063252)	(4.588304)	(2.065019)	(1.144656)	(3.994198)	(3.273664)	(1.958995)	
Northeast	-26.67108***	-3.081789	2.366071	-2.766031**	-0.604137	-14.79651***	-16.11599***	-6.710648***	-1.471883	-3.818348	-11.55479***	1.735082	0.2506
	(4.601581)	(2.451151)	(2.742874)	(1.399747)	(0.556729)	(3.993474)	(4.509509)	(2.029557)	(1.124999)	(3.925606)	(3.217445)	(1.925353)	
South	-23.8679***	-4.16841	3.920834	-1.418435	-0.896342	-11.41522**	-14.55423***	-7.383451***	-1.809201	6.628814	-8.136769**	1.651182	0.1078
	(5.173085)	(2.755578)	(3.083532)	(1.573592)	(0.625873)	(4.489453)	(5.069578)	(2.281622)	(1.264721)	(4.413156)	(3.617044)	(2.164477)	
Rural	1.759068	-0.567531	-0.612946	-1.122123	-0.087907	-2.420183	-0.446346	0.197236	-1.254808*	-2.635728	-0.878603	-0.9622	0.2431
	(2.772831)	(1.47702)	(1.652807)	(0.843463)	(0.335475)	(2.406397)	(2.71735)	(1.222975)	(0.677905)	(2.365501)	(1.938776)	(1.160184)	
R-squared	0.4051	0.2984	0.2128	0.4778	0.1740	0.0858	0.6420	0.3633	0.3286	0.3037	0.2884	0.0816	
Number of households	399	399	399	399	399	399	399	399	399	399	399	399	399

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix A 5. Quasi-quadratic Engel curve (1.16) for spouses with one dependent

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	12.79448***	5.476991***	-4.612895*	0.180664	-0.595774	-2.70354	6.3203	6.760887**	-3.62796**	14.61518***	10.0828***	2.771065	
	(4.332992)	(1.895925)	(2.671023)	(2.670517)	(0.800929)	(3.252394)	(5.636794)	(3.04188)	(1.756414)	(4.923672)	(3.807634)	(2.968186)	
Young children	-0.851288	-1.152348	0.207451	6.420221***	-0.029564	-0.711388	-6.055188***	-5.043804***	-0.126989	9.724024***	-2.797857*	0.378251	0.3191
	(1.752927)	(0.767003)	(1.080572)	(1.080367)	(0.324019)	(1.315768)	(2.280385)	(1.230603)	(0.710564)	(1.991889)	(1.540392)	(1.20079)	
Older children	-2.316924*	-2.016196***	0.377677	0.988459	0.027894	-2.255134**	-1.934853	-1.796851*	0.450343	2.191912	-0.741229	1.797746*	0.4350
	(1.400101)	(0.612622)	(0.863076)	(0.862913)	(0.258801)	(1.050932)	(1.821393)	(0.98291)	(0.567542)	(1.590965)	(1.230344)	(0.959097)	
Home owner	8.013226***	0.868914*	0.469393	0.455175	0.310397	-0.077843	1.528403	0.668418	-0.011623	1.664642	0.976525	-1.170772	0.5875
	(1.158808)	(0.507043)	(0.714334)	(0.714199)	(0.214199)	(0.869815)	(1.507495)	(0.813516)	(0.469733)	(1.316779)	(1.018307)	(0.793807)	
Vehicle owner	-0.010067	0.075167	0.66263	0.573281	0.022354	-0.035291	7.243138***	0.879619	0.977761	1.135247	0.649136	1.683064	0.8913
	(1.821296)	(0.796918)	(1.122717)	(1.122505)	(0.336656)	(1.367086)	(2.369327)	(1.2786)	(0.738278)	(2.069578)	(1.600471)	(1.247624)	
Husband age	-0.06519	-0.006395	-0.035935	0.065446	-0.010473	0.020196	-0.004779	-0.111084	0.012182	-0.152688	0.011538	-0.104053	40.2884
	(0.1185)	(0.05185)	(0.073048)	(0.073034)	(0.021904)	(0.088947)	(0.154156)	(0.08319)	(0.048035)	(0.134654)	(0.104132)	(0.081175)	
Wife age	0.098891	0.01585	0.006449	-0.018967	0.006189	0.140121	-0.175779	0.040034	0.028264	0.391026***	0.063746	0.096924	37.8712
	(0.123943)	(0.054232)	(0.076403)	(0.076389)	(0.02291)	(0.093033)	(0.161237)	(0.087011)	(0.050241)	(0.140839)	(0.108915)	(0.084903)	
Husband education (year)	0.593547***	0.075063	0.163388	0.255041**	-0.036193	-0.020526	0.506525**	0.036229	0.191756**	-0.003573	0.161746	0.058793	10.7742
	(0.197332)	(0.086344)	(0.121643)	(0.12162)	(0.036476)	(0.148119)	(0.256709)	(0.138532)	(0.07999)	(0.224232)	(0.173406)	(0.135176)	
Wife education (year)	0.435222**	0.07498	0.080594	0.269689**	0.086663**	0.340974**	0.143702	-0.053185	-0.09426	0.363304	0.591672***	-0.052489	10.8416
	(0.199867)	(0.087453)	(0.123206)	(0.123182)	(0.036944)	(0.150022)	(0.260007)	(0.140312)	(0.081018)	(0.227113)	(0.175634)	(0.136913)	
Husband wage&salary	-0.551644	0.059427	-0.497515	0.380871	0.129054	0.803305	-1.241789	-0.534991	-0.633581**	-0.332678	0.044365	0.381616	130.1483
	(0.750791)	(0.328513)	(0.462816)	(0.462729)	(0.13878)	(0.563552)	(0.976705)	(0.527076)	(0.304339)	(0.85314)	(0.65976)	(0.514307)	
Wife wage&salary	-0.575648	0.041686	-0.514236	0.444859	0.128818	0.789134	-1.205399	-0.609739	-0.588867*	-0.276517	0.003351	0.382079	106.9741
	(0.749851)	(0.328102)	(0.462237)	(0.46215)	(0.138606)	(0.562847)	(0.975482)	(0.526416)	(0.303958)	(0.852072)	(0.658935)	(0.513663)	
HH total income	0.592926	-0.02107	0.541448	-0.432231	-0.120185	-0.798383	1.379719	0.593148	0.63471**	0.374672	-0.01575	-0.375688	237.5311
	(0.752121)	(0.329095)	(0.463636)	(0.463548)	(0.139025)	(0.564551)	(0.978435)	(0.52801)	(0.304878)	(0.854651)	(0.660929)	(0.515218)	
Husband w&s square	0.001149	-0.000181	0.00074	-0.000553	-0.000175	-0.001245	0.002189	0.001184	0.000996**	0.000771	0.000043	-0.001583**	28431.7100
	(0.00108)	(0.000473)	(0.000666)	(0.000666)	(0.0002)	(0.000811)	(0.001405)	(0.000758)	(0.000438)	(0.001227)	(0.000949)	(0.00074)	
Wife w&s square	0.001148	-0.000199	0.000763	-0.000684	-0.000178	-0.001216	0.002108	0.001321*	0.000919**	0.000671	0.000075	-0.001594**	20141.5100
	(0.00108)	(0.000472)	(0.000666)	(0.000665)	(0.0002)	(0.00081)	(0.001404)	(0.000758)	(0.000438)	(0.001227)	(0.000949)	(0.00074)	
HH total income square	-0.001117	0.000176	-0.000785	0.000706	0.000169	0.001209	-0.002165	-0.001271*	-0.00095**	-0.000758	-0.00007	0.001661**	91898.2000
	(0.001081)	(0.000473)	(0.000667)	(0.000666)	(0.0002)	(0.000812)	(0.001407)	(0.000759)	(0.000438)	(0.001229)	(0.00095)	(0.000741)	
Husws * Wifews	0.002164	-0.000374	0.001571	-0.001448	-0.000343	-0.00232	0.004137	0.002606*	0.001838**	0.001417	0.000196	-0.003494**	21556.7100
	(0.002163)	(0.000946)	(0.001333)	(0.001333)	(0.0004)	(0.001624)	(0.002814)	(0.001518)	(0.000877)	(0.002458)	(0.001901)	(0.001482)	
Central	-10.19712***	-1.097586	2.906194**	-2.023302*	-0.083334	-2.685098*	-5.545112**	-3.15031**	0.298651	-2.584781	-5.437917***	1.12183	0.3865
	(1.899545)	(0.831157)	(1.170953)	(1.170731)	(0.35112)	(1.425821)	(2.47112)	(1.333533)	(0.769996)	(2.158494)	(1.669233)	(1.301226)	
North	-15.72496***	-2.744142***	2.952715**	-3.660848***	-0.145347	-2.363084	-14.23893***	-3.025281**	-1.422878*	-6.092405***	-9.791634***	-1.651092	0.2092
	(2.058372)	(0.900652)	(1.26886)	(1.26862)	(0.380479)	(1.545038)	(2.677739)	(1.445034)	(0.834378)	(2.338973)	(1.808803)	(1.410026)	
Northeast	-19.13615***	-3.904535***	1.3714	-3.466197***	-0.410413	-5.11378***	-17.54489***	-7.520353***	-1.306094	-7.732446***	-14.02867***	0.343628	0.1631
	(2.152244)	(0.941727)	(1.326726)	(1.326475)	(0.39783)	(1.6155)	(2.799857)	(1.510935)	(0.87243)	(2.445641)	(1.891293)	(1.47433)	
South	-11.27008***	-2.765308***	4.260886***	-4.056797***	-0.170738	-2.059059	-9.238881***	-2.212189	-0.797563	-1.72065	-7.331278***	-0.111605	0.1312
	(2.26239)	(0.989921)	(1.394624)	(1.39436)	(0.41819)	(1.698176)	(2.943146)	(1.58826)	(0.917078)	(2.570802)	(1.988084)	(1.549782)	
Rural	-2.425054*	-0.550168	-1.427075*	0.229882	-0.269514	-0.52934	-0.253972	0.332371	0.030025	-2.351198	0.407481	0.868508	0.2541
	(1.304719)	(0.570887)	(0.804279)	(0.804127)	(0.24117)	(0.979338)	(1.697311)	(0.915949)	(0.528879)	(1.482581)	(1.146528)	(0.893759)	
R-squared	0.4049	0.3869	0.2409	0.3478	0.1787	0.1052	0.6201	0.1995	0.2727	0.2669	0.2191	0.0705	
Number of households	846	846	846	846	846	846	846	846	846	846	846	846	846

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix A 6. Quasi-quadratic Engel curve (1.16) for spouses with two dependents

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	26.57127***	0.422331	-4.147706	-1.933589	0.10764	20.60135***	-1.206732	-0.566583	-2.334763	21.42694***	16.51493***	-0.663045	
	(9.241426)	(4.706405)	(4.352953)	(2.91438)	(1.065795)	(6.009491)	(7.423138)	(3.652088)	(2.405733)	(6.773559)	(5.482202)	(4.462277)	
Young children	-4.316347**	0.026191	0.712987	3.664838***	-0.029105	-1.254356	-2.693841	-2.217451***	-0.137657	3.532913**	-3.347035***	1.156379	0.3709
	(2.12391)	(1.081649)	(1.000417)	(0.669797)	(0.244946)	(1.381131)	(1.706022)	(0.839341)	(0.552898)	(1.556733)	(1.259947)	(1.025543)	
Older children	-5.762177***	-0.250938	1.380295**	0.098409	0.180738	-2.040776**	-0.288459	-1.560161***	-0.257989	0.900365	-1.946465**	1.454237**	1.0742
	(1.462999)	(0.745065)	(0.689111)	(0.461372)	(0.168725)	(0.951355)	(1.175148)	(0.578158)	(0.380849)	(1.072314)	(0.867881)	(0.706418)	
Home owner	8.959116***	0.908507	0.631952	-0.014738	-0.004347	0.249625	3.154413*	0.265819	0.418736	-2.226798	2.18026*	-0.751238	0.6731
	(2.032995)	(1.035348)	(0.957594)	(0.641126)	(0.234461)	(1.322011)	(1.632995)	(0.803412)	(0.52923)	(1.490096)	(1.206014)	(0.981644)	
Vehicle owner	7.199706**	0.992653	0.173631	0.623676	0.056327	-3.845061*	7.137393**	1.819573	1.408481	2.293726	-1.346735	-0.162378	0.9203
	(3.534078)	(1.799809)	(1.664643)	(1.114508)	(0.407578)	(2.298132)	(2.838734)	(1.39662)	(0.919993)	(2.590324)	(2.096487)	(1.706451)	
Husband age	-0.183863	0.038478	-0.057404	-0.007812	-0.008369	-0.216112	-0.26613	-0.08935	0.004078	-0.037324	-0.05117	0.007255	40.9560
	(0.221552)	(0.11283)	(0.104357)	(0.069869)	(0.025551)	(0.14407)	(0.17796)	(0.087554)	(0.057674)	(0.162388)	(0.131429)	(0.106978)	
Wife age	0.022098	0.062306	-0.001829	0.070091	-0.00888	-0.148327	0.199006	0.279782***	0.028581	0.044839	0.018552	0.043566	38.2967
	(0.241157)	(0.122815)	(0.113591)	(0.076051)	(0.027812)	(0.156819)	(0.193708)	(0.095302)	(0.062778)	(0.176757)	(0.143059)	(0.116444)	
Husband education (year)	0.377213	0.273932	0.103442	-0.021146	0.025407	-0.033492	0.811286***	0.191074	0.029546	0.029085	-0.248967	-0.014238	11.0783
	(0.362185)	(0.184451)	(0.170599)	(0.114219)	(0.04177)	(0.235521)	(0.290924)	(0.143131)	(0.094284)	(0.265466)	(0.214856)	(0.174883)	
Wife education (year)	-0.106001	0.100877	0.173102	0.225154**	0.036444	-0.140429	0.642523**	0.015631	-0.004041	0.172539	0.437796**	-0.15841	11.1635
	(0.351893)	(0.179209)	(0.165751)	(0.110973)	(0.040583)	(0.228828)	(0.282657)	(0.139063)	(0.091605)	(0.257922)	(0.20875)	(0.169914)	
Husband wage&salary	-0.537879	0.170747	-0.273897	1.27587***	0.103746	0.29322	0.380426	0.080291	-0.050005	0.397966	0.267274	0.050983	145.2872
	(1.136455)	(0.578766)	(0.5353)	(0.358393)	(0.131065)	(0.739011)	(0.912853)	(0.449112)	(0.295843)	(0.832972)	(0.674169)	(0.548744)	
Wife wage&salary	-0.571666	0.154227	-0.339795	1.28442***	0.091446	0.34892	0.310824	0.108725	-0.042167	0.293732	0.219799	0.036736	110.7878
	(1.137003)	(0.579045)	(0.535558)	(0.358566)	(0.131128)	(0.739368)	(0.913293)	(0.449329)	(0.295985)	(0.833374)	(0.674494)	(0.549009)	
HH total income	0.65008	-0.144902	0.331296	-1.277474***	-0.092622	-0.283581	-0.246294	-0.084403	0.065334	-0.254102	-0.191373	-0.030884	256.6934
	(1.137597)	(0.579347)	(0.535838)	(0.358753)	(0.131197)	(0.739754)	(0.91377)	(0.449563)	(0.29614)	(0.833809)	(0.674846)	(0.549296)	
Husband w&s square	0.000315	-0.000185	0.000108	-0.00198***	-0.000064	-0.000431	-0.001642**	-0.000007	-0.000196	-0.000681	-0.000004	0.000039	34634.3300
	(0.000938)	(0.000478)	(0.000442)	(0.000296)	(0.000108)	(0.00061)	(0.000753)	(0.000371)	(0.000244)	(0.000687)	(0.000556)	(0.000453)	
Wife w&s square	0.00046	-0.000148	0.000188	-0.001993***	-0.000048	-0.000471	-0.001588**	-0.00009	-0.000202	-0.000548	0.000043	0.000019	22356.4000
	(0.000938)	(0.000478)	(0.000442)	(0.000296)	(0.000108)	(0.00061)	(0.000754)	(0.000371)	(0.000244)	(0.000688)	(0.000557)	(0.000453)	
HH total income square	-0.00036	0.000153	-0.000199	0.001984***	0.000046	0.000482	0.001659**	0.000137	0.000178	0.000524	-0.000052	-0.000052	104740.5000
	(0.000939)	(0.000478)	(0.000442)	(0.000296)	(0.000108)	(0.00061)	(0.000754)	(0.000371)	(0.000244)	(0.000688)	(0.000557)	(0.000453)	
Husws * Wifews	0.0005	-0.000243	0.000528	-0.003903***	-0.000061	-0.001112	-0.003432**	-0.000425	-0.000325	-0.001028	0.000095	0.000162	23657.0200
	(0.00188)	(0.000958)	(0.000886)	(0.000593)	(0.000217)	(0.001223)	(0.00151)	(0.000743)	(0.00049)	(0.001378)	(0.001116)	(0.000908)	
Central	-20.28266***	-0.687787	3.797908**	0.514333	-0.226804	-1.666941	-4.402607	-3.028019**	0.197695	1.896207	-3.27331	1.897815	0.3819
	(3.512949)	(1.789049)	(1.654691)	(1.107845)	(0.405141)	(2.284392)	(2.821762)	(1.38827)	(0.914493)	(2.574838)	(2.083953)	(1.696248)	
North	-26.86319***	-1.292619	3.662071**	-0.269008	-0.292961	-2.309609	-14.3821***	-4.991682***	-0.884474	-1.99019	-8.785373***	2.56529	0.1676
	(3.870522)	(1.971151)	(1.823117)	(1.220609)	(0.446379)	(2.516913)	(3.108981)	(1.529578)	(1.007576)	(2.836923)	(2.296072)	(1.868905)	
Northeast	-26.86223***	-4.358642**	1.608866**	1.364279	-0.294077	-1.891628	-12.66395***	-7.036793***	-1.975325**	0.699259	-8.656334***	2.845479	0.2294
	(3.791379)	(1.930845)	(1.785838)	(1.195651)	(0.437252)	(2.465449)	(3.04541)	(1.498302)	(0.986974)	(2.778914)	(2.249123)	(1.83069)	
South	-22.71168***	-3.528906*	3.193109*	1.175814	-0.585758	-2.150421	-10.86817***	-5.951149***	-1.816837*	1.91614	-5.830346**	1.520172	0.1277
	(4.078576)	(2.077107)	(1.921116)	(1.286221)	(0.470374)	(2.652206)	(3.2761)	(1.611799)	(1.061737)	(2.989417)	(2.419494)	(1.969365)	
Rural	-1.255351	-1.166706	-1.497731	-0.739067	-0.17851	0.256392	0.30967	-1.444751	-0.71541	-1.295683	-3.315538**	-0.271386	0.2473
	(2.320089)	(1.181558)	(1.092823)	(0.731664)	(0.267571)	(1.508702)	(1.863602)	(0.916868)	(0.603967)	(1.700523)	(1.376324)	(1.120269)	
R-squared	0.3607	0.2260	0.2388	0.3794	0.2153	0.0679	0.6660	0.4248	0.2500	0.3129	0.2904	0.0545	
Number of households	728	728	728	728	728	728	728	728	728	728	728	728	728

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix A 7. Quasi-quadratic Engel curve (1.16) for spouses with three or more dependents

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Health	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	8.547077	16.46707*	-2.333299	3.389664	-0.193932	2.421535	28.20125**	-2.975294	0.194233	13.762	32.27221***	14.78565**	
	(12.09144)	(8.78621)	(7.286625)	(9.608259)	(3.465135)	(9.254264)	(14.36026)	(6.19526)	(3.938471)	(13.3214)	(9.462197)	(5.975101)	
Young children	2.798074	-0.254189	-1.072673	2.133234	-0.37233	-0.232608	-3.150529	-1.377744	0.021748	4.974664**	-3.707135**	-1.463399	0.5657
	(2.109196)	(1.532641)	(1.271058)	(1.676037)	(0.604448)	(1.614287)	(2.504963)	(1.080683)	(0.687015)	(2.323746)	(1.650558)	(1.042279)	
Older children	-1.450992	-1.395916	1.033549	-0.711589	0.181134	0.554589	-3.367946*	0.930408	-0.073975	1.985453	-0.244731	-1.196805	1.4502
	(1.485844)	(1.079684)	(0.895409)	(1.180701)	(0.425809)	(1.1372)	(1.764646)	(0.761298)	(0.483975)	(1.636986)	(1.162752)	(0.734244)	
Home owner	2.462563	0.013665	-1.541948	-1.021355	0.52568	0.741642	2.73049	0.161404	0.83654	1.657095	0.751924	-0.581556	0.7689
	(3.101323)	(2.253567)	(1.86894)	(2.464414)	(0.888769)	(2.373618)	(3.683251)	(1.589016)	(1.010175)	(3.416793)	(2.42695)	(1.532548)	
Vehicle owner	4.186755	-0.249462	-1.970591	2.31472	-0.831367	2.281807	7.365098	2.155396	0.890417	-4.761421	-2.10659	-2.719771	0.9084
	(4.574312)	(3.32391)	(2.756602)	(3.634899)	(1.310895)	(3.500979)	(5.432629)	(2.343728)	(1.489962)	(5.039616)	(3.579642)	(2.26044)	
Husband age	0.314517	-0.107451	0.041086	-0.063284	-0.065259	-0.104293	-0.468164	-0.011425	0.024011	-0.217645	-0.230743	-0.280232*	41.5538
	(0.292656)	(0.212658)	(0.176362)	(0.232554)	(0.083869)	(0.223986)	(0.34757)	(0.149947)	(0.095325)	(0.322425)	(0.229019)	(0.144619)	
Wife age	0.085908	0.016402	-0.057137	0.243163	0.055351	0.100997	0.089245	0.153366	0.009129	0.52711	-0.052263	0.109627	38.6056
	(0.305946)	(0.222314)	(0.184371)	(0.243114)	(0.087677)	(0.234157)	(0.363353)	(0.156756)	(0.099654)	(0.337067)	(0.239419)	(0.151186)	
Husband education (year)	0.639956	0.007552	-0.108642	0.399614	-0.035823	0.011047	-0.062146	0.159601	0.062001	0.770316	0.244706	-0.378768	11.2709
	(0.502172)	(0.364902)	(0.302622)	(0.399043)	(0.143911)	(0.384341)	(0.596399)	(0.257297)	(0.163569)	(0.553254)	(0.392976)	(0.248153)	
Wife education (year)	0.79324	-0.17571	0.289989	0.031897	0.140581	0.328564	-0.852366	0.220052	-0.347528**	0.762081	-0.514792	0.152814	11.0757
	(0.493762)	(0.358791)	(0.297554)	(0.39236)	(0.141501)	(0.377904)	(0.586411)	(0.252988)	(0.16083)	(0.543988)	(0.386395)	(0.243997)	
Husband wage&salary	-1.100844	-0.885352	0.353733	-1.410041	-1.637057***	-1.55066	-8.177338***	0.062293	-1.028987**	-3.25263**	0.651087	-0.255841	154.0608
	(1.432171)	(1.040682)	(0.863064)	(1.13805)	(0.410428)	(1.096121)	(1.700901)	(0.733797)	(0.466492)	(1.577853)	(1.12075)	(0.707721)	
Wife wage&salary	-1.394158	-0.935014	0.362778	-1.360113	-1.595861***	-1.510812	-8.121706***	0.062203	-1.070528**	-3.208319**	0.647094	-0.307668	117.6607
	(1.439326)	(1.045882)	(0.867376)	(1.143736)	(0.412479)	(1.101598)	(1.7094)	(0.737464)	(0.468823)	(1.585736)	(1.126349)	(0.711257)	
HH total income	1.208933	0.972206	-0.321435	1.399244	1.618042***	1.542579	8.346662***	-0.05513	1.069425**	3.272624**	-0.601342	0.2969	272.4781
	(1.436973)	(1.044172)	(0.865958)	(1.141866)	(0.411804)	(1.099797)	(1.706605)	(0.736258)	(0.468056)	(1.583144)	(1.124508)	(0.710094)	
Husband w&s square	0.002441*	0.001116	0.000612	0.001905*	0.00099***	0.001064	0.00845***	-0.001545**	0.001591***	0.002308*	-0.000922	-0.000308	49562.6700
	(0.001263)	(0.000918)	(0.000761)	(0.001004)	(0.000362)	(0.000967)	(0.0015)	(0.000647)	(0.000411)	(0.001391)	(0.000988)	(0.000624)	
Wife w&s square	0.003185**	0.000992	0.000563	0.001781*	0.00091**	0.000999	0.008083***	-0.001389**	0.001654***	0.002288	-0.00092	-0.000302	25944.6500
	(0.00128)	(0.00093)	(0.000771)	(0.001017)	(0.000367)	(0.00098)	(0.00152)	(0.000656)	(0.000417)	(0.00141)	(0.001002)	(0.000632)	
HH total income square	-0.002579**	-0.001095	-0.000635	-0.00177*	-0.000907**	-0.001051	-0.008342***	0.001645**	-0.001663***	-0.002278	0.00086	0.000355	141986.4000
	(0.001279)	(0.00093)	(0.000771)	(0.001016)	(0.000367)	(0.000979)	(0.001519)	(0.000655)	(0.000417)	(0.001409)	(0.001001)	(0.000632)	
Husws * Wifews	0.005187**	0.002179	0.001356	0.00339	0.001727**	0.002087	0.016678***	-0.003577***	0.003463***	0.004476	-0.001589	-0.000863	32967.8400
	(0.002604)	(0.001892)	(0.001569)	(0.002069)	(0.000746)	(0.001993)	(0.003093)	(0.001334)	(0.000848)	(0.002869)	(0.002038)	(0.001287)	
Central	-20.67589***	-8.856211***	2.911524	-14.04081***	0.067781	-4.534201	-13.63497**	-6.331628***	-2.09632	-5.301891	-1.881363	1.339905	0.3506
	(4.712235)	(3.424131)	(2.839718)	(3.744497)	(1.35042)	(3.606539)	(5.596432)	(2.414395)	(1.534887)	(5.191568)	(3.687574)	(2.328596)	
North	-24.18938***	-4.95902	3.768054	-13.17022***	1.230315	-6.272654	-17.10762***	-3.334177	-2.330186	-3.013276	-7.816831**	2.119136	0.1753
	(5.007096)	(3.638391)	(3.017409)	(3.978803)	(1.434921)	(3.832213)	(5.94662)	(2.565472)	(1.63093)	(5.516423)	(3.918319)	(2.474304)	
Northeast	-26.2663***	-9.631693***	2.984265	-15.78655***	0.045373	-8.765829**	-18.08777***	-6.651532***	-2.901391*	-9.476299*	-5.307282	3.594312	0.2351
	(4.910194)	(3.567978)	(2.959013)	(3.901802)	(1.407151)	(3.758049)	(5.831536)	(2.515823)	(1.599367)	(5.409664)	(3.842488)	(2.426419)	
South	-23.16509***	-7.522788*	5.269604	-14.18999***	-0.08498	-5.223202	-14.34795**	-4.940149*	-3.561882**	-3.468333	-6.215716	4.447199*	0.1434
	(5.371892)	(3.903469)	(3.237245)	(4.268683)	(1.539463)	(4.111412)	(6.379867)	(2.752382)	(1.749753)	(5.918327)	(4.203791)	(2.654571)	
Rural	1.091531	-1.585689	1.006908	1.132775	-0.057194	-3.529524	-0.507353	0.326494	0.075942	2.156722	-1.934741	-1.045555	0.2470
	(3.038941)	(2.208237)	(1.831347)	(2.414843)	(0.870892)	(2.325873)	(3.609164)	(1.557054)	(0.989855)	(3.348065)	(2.378133)	(1.501721)	
R-squared	0.5786	0.5390	0.4158	0.6408	0.7703	0.0767	0.8555	0.5750	0.4873	0.3275	0.4003	0.0998	
Number of households	251	251	251	251	251	251	251	251	251	251	251	251	251

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

APPENDIX B: ESTIMATES OF QUADRATIC ALMOST IDEAL DEMAND SYSTEM

Appendix B 1. QUAIDS Engel curve (1.17) for households with spouses only (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	84.28641**	-0.051388	27.63119	8.00849	-8.05075	-110.6886***	6.193183	9.625024	133.5254***	-15.03815	-51.47541*	
	(37.15709)	(13.83926)	(18.0156)	(8.635747)	(5.826972)	(33.84887)	(5.342912)	(10.03086)	(37.21412)	(36.97279)	(26.41305)	
Home owner	0.999859	0.830132**	-0.602949	-0.037944	0.235059	0.192939	0.247614*	0.027153	-0.219574	-0.710806	-1.394423**	0.3096
	(0.932178)	(0.347192)	(0.451966)	(0.216649)	(0.146184)	(0.849183)	(0.13404)	(0.251649)	(0.933609)	(0.927554)	(0.662637)	
Vehicle owner	-0.637037	-0.051404	-0.05946	-0.221524	0.023597	2.257201***	0.036735	0.340923*	-0.730146	-1.33044*	0.098934	0.7238
	(0.728019)	(0.271153)	(0.35298)	(0.1692)	(0.114168)	(0.663201)	(0.104684)	(0.196535)	(0.729137)	(0.724408)	(0.517511)	
Husband age	0.112346*	0.000068	0.019026	-0.019195	-0.006409	-0.018127	0.00434	0.004478	0.103379*	-0.171905***	-0.059456	36.3231
	(0.062017)	(0.023098)	(0.030069)	(0.014413)	(0.009726)	(0.056495)	(0.008918)	(0.016742)	(0.062112)	(0.061709)	(0.044085)	
Wife age	0.045003	0.062225***	-0.01033	-0.006292	-0.010899	-0.00302	-0.011699	-0.00668	0.007924	-0.125764*	0.068283	34.0821
	(0.065196)	(0.024282)	(0.03161)	(0.015152)	(0.010224)	(0.059391)	(0.009375)	(0.0176)	(0.065296)	(0.064873)	(0.046345)	
Husband education (year)	0.02076	-0.059387	0.065013	0.028078	0.022271	0.234179**	0.01027	0.076882**	-0.022137	-0.065965	-0.283465***	10.1507
	(0.111978)	(0.041707)	(0.054293)	(0.026025)	(0.01756)	(0.102009)	(0.016102)	(0.03023)	(0.11215)	(0.111423)	(0.0796)	
Wife education (year)	-0.185137	0.118296***	0.017977	0.039078	0.018295	0.068508	0.015515	0.00204	-0.063183	-0.075485	-0.031111	10.1182
	(0.122958)	(0.045796)	(0.059616)	(0.028577)	(0.019282)	(0.11201)	(0.01768)	(0.033193)	(0.123146)	(0.122348)	(0.087404)	
Log (husband wages)	-6.773888***	0.108887	-0.338193	0.0641	0.083146	3.730491***	0.230589	0.324616	-0.118251	1.421979	0.849948	4.4212
	(1.325887)	(0.49383)	(0.642856)	(0.308152)	(0.207926)	(1.207839)	(0.190653)	(0.357934)	(1.327922)	(1.319311)	(0.942505)	
Log (wife wages)	-3.459142***	-1.117143**	0.010165	0.154933	0.215617	2.414731**	0.178787	0.311803	-2.06128*	4.322217***	-1.424448*	4.2504
	(1.208454)	(0.450092)	(0.585918)	(0.280859)	(0.18951)	(1.100861)	(0.173767)	(0.326232)	(1.210308)	(1.20246)	(0.859027)	
Log (household total consumption)	-27.03742*	4.244475	-13.34883*	-1.520138	3.232377	42.25734***	-2.575538	-4.792563	-32.02371**	14.88081	23.86739**	4.7121
	(15.44469)	(5.752418)	(7.488351)	(3.589529)	(2.422035)	(14.0696)	(2.220831)	(4.169422)	(15.4684)	(15.36809)	(10.97883)	
Log (hh total consumption) squared	4.533978***	-0.532813	1.699091**	0.104234	-0.33643	-4.45035***	0.18289	0.490124	2.226291	-2.263978	-2.274028*	22.4408
	(1.717505)	(0.639689)	(0.832731)	(0.399169)	(0.269339)	(1.56459)	(0.246964)	(0.463655)	(1.720141)	(1.708986)	(1.220885)	
Central	-2.551083***	-0.011322	1.291381***	-0.199486	-0.050964	-0.401731	0.052617	0.278501	1.723953**	-0.673497	0.607026	0.5135
	(0.834451)	(0.310794)	(0.404583)	(0.193936)	(0.130859)	(0.760157)	(0.119988)	(0.225267)	(0.835732)	(0.830313)	(0.593168)	
North	-1.335696	-0.251736	2.227773***	-0.084207	0.08386	-0.742662	0.013589	0.200673	1.320719	-2.961997**	1.475402	0.1119
	(1.288967)	(0.480079)	(0.624955)	(0.299571)	(0.202136)	(1.174206)	(0.185344)	(0.347967)	(1.290945)	(1.282573)	(0.91626)	
Northeast	-0.737175	-0.112064	2.216806***	-0.228905	0.150778	0.419006	0.07906	-0.276344	2.180358	-5.185967***	1.954531**	0.1092
	(1.390963)	(0.518068)	(0.674408)	(0.323276)	(0.218131)	(1.267121)	(0.20001)	(0.375502)	(1.393098)	(1.384064)	(0.988764)	
South	0.054324	-0.676493	1.493832**	-0.198181	-0.065304	-2.697185**	-0.05553	-0.021174	2.72264**	-1.696956	1.099031	0.0930
	(1.227817)	(0.457304)	(0.595307)	(0.285359)	(0.192546)	(1.1185)	(0.176551)	(0.331459)	(1.229702)	(1.221727)	(0.872792)	
Rural	0.311812	0.090743	0.412402	-0.107876	0.015846	1.029419*	-0.129629	-0.247541	0.446782	-1.783921***	0.409761	0.2527
	(0.687242)	(0.255965)	(0.333209)	(0.159723)	(0.107773)	(0.626054)	(0.09882)	(0.185527)	(0.688297)	(0.683833)	(0.488525)	
R-squared	-0.3671	0.0687	0.1171	0.0272	0.0700	0.2850	-0.0326	0.0809	0.3272	0.1459	0.0652	
Number of households	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108	1108

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix B 2. QUAIDS Engel curve (1.17) for households with kids, no others (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	-27.07517	46.70066***	-13.06479	38.16406***	3.825765	-48.72525*	-6.110155	8.864514	192.1982***	-80.93303***	-7.243901	
	(18.7014)	(9.851053)	(12.20895)	(11.6437)	(3.183122)	(25.18992)	(7.898942)	(6.026867)	(29.78319)	(20.36396)	(14.65968)	
Household size	-0.730986*	0.82168***	0.385655	-0.3629	-0.020674	-2.381946***	0.745909***	-0.164009	2.489822***	-0.430252	-0.386112	3.4874
	(0.383406)	(0.201961)	(0.250301)	(0.238713)	(0.065259)	(0.51643)	(0.16194)	(0.12356)	(0.610599)	(0.417491)	(0.300545)	
Home owner	3.272844***	0.200861	0.08528	-0.725894**	-0.073228	-0.849914	0.172063	0.00497	-0.460428	-0.371751	-1.017421***	0.5549
	(0.462644)	(0.2437)	(0.302031)	(0.288047)	(0.078746)	(0.62316)	(0.195408)	(0.149096)	(0.736791)	(0.503773)	(0.362658)	
Vehicle owner	-1.811373**	0.477367	0.217669	-0.209921	0.093963	1.72237	0.692103**	0.726058***	1.694695	-2.963834***	0.043822	0.8948
	(0.790274)	(0.416281)	(0.515919)	(0.492033)	(0.134511)	(1.064462)	(0.333789)	(0.25468)	(1.258562)	(0.86053)	(0.619481)	
Husband age	0.05554	-0.010764	-0.021783	-0.020235	0.000901	0.081714	-0.003931	0.024291	-0.094235	0.003674	-0.008215	38.2932
	(0.048068)	(0.02532)	(0.031381)	(0.029928)	(0.008182)	(0.064745)	(0.020303)	(0.015491)	(0.076551)	(0.052341)	(0.03768)	
Wife age	-0.036293	0.024325	0.002598	-0.088932***	-0.005311	-0.053111	0.065179***	0.022501	0.089348	-0.006282	0.012933	35.7113
	(0.049871)	(0.02627)	(0.032558)	(0.03105)	(0.008488)	(0.067174)	(0.021064)	(0.016072)	(0.079423)	(0.054305)	(0.039093)	
Husband education (year)	0.070495	0.121219***	0.084918	0.021044	-0.009573	-0.057506	0.010461	0.071084**	0.035768	-0.259386***	-0.010415	10.6124
	(0.089215)	(0.046994)	(0.058243)	(0.055546)	(0.015185)	(0.120168)	(0.037682)	(0.028751)	(0.14208)	(0.097146)	(0.069934)	
Wife education (year)	0.011183	0.042395	0.051959	0.0526	0.022837	-0.082679	0.038484	0.013522	0.140702	-0.126655	-0.187247***	10.6484
	(0.090371)	(0.047603)	(0.058997)	(0.056266)	(0.015382)	(0.121725)	(0.03817)	(0.029124)	(0.143921)	(0.098405)	(0.07084)	
Log (husband wages)	-0.844596	1.878057***	0.879979	-1.064711	0.005645	-3.002602**	0.787537*	0.609969*	4.509908**	-2.439566**	-0.480919	4.5320
	(1.135116)	(0.597928)	(0.741045)	(0.706736)	(0.193205)	(1.528948)	(0.479441)	(0.365812)	(1.807745)	(1.236028)	(0.889796)	
Log (wife wages)	-1.80264**	0.456231	-0.489545	-0.039548	-0.006513	-0.866147	0.31788	0.154003	2.595327**	-0.186072	0.175832	4.2619
	(0.711058)	(0.374553)	(0.464204)	(0.442712)	(0.121028)	(0.957762)	(0.300331)	(0.229151)	(1.132405)	(0.774271)	(0.557385)	
Log (household total consumption)	19.79739***	-16.01339***	3.87378	-11.75277**	-2.080678	19.12037*	0.163246	-4.563137*	-55.30267***	38.49522***	4.925731	4.9004
	(7.586763)	(3.996363)	(4.952912)	(4.723601)	(1.291325)	(10.21901)	(3.204433)	(2.444972)	(12.08241)	(8.261229)	(5.947123)	
Log (hh total consumption) squared	-1.736469**	0.986341***	-0.324995	1.41303***	0.285225**	-0.158811	-0.080013	0.376655*	2.846081***	-3.168636***	-0.389921	24.3101
	(0.691695)	(0.364354)	(0.451564)	(0.430657)	(0.117732)	(0.931681)	(0.292152)	(0.222911)	(1.101569)	(0.753187)	(0.542207)	
Central	-1.190084	-0.628228	1.896695***	-0.817846	0.074493	-0.078204	-1.004509***	0.300872	-0.960786	0.108061	2.216059***	0.3786
	(0.812016)	(0.427733)	(0.530113)	(0.50557)	(0.138211)	(1.093747)	(0.342973)	(0.261687)	(1.293188)	(0.884204)	(0.636524)	
North	-1.219607	-1.501333**	3.088974***	-0.602981	0.347936*	2.175121*	-1.005702**	-0.23559	-4.286141**	0.385756	2.06145**	0.1871
	(1.199282)	(0.631727)	(0.782934)	(0.746686)	(0.204127)	(1.615376)	(0.506543)	(0.38649)	(1.909933)	(1.305898)	(0.940095)	
Northeast	-1.499981	-1.872099***	1.376052*	0.147616	0.189557	2.293262	-2.236365***	-0.204434	-1.772685	0.772038	2.266103**	0.1691
	(1.204216)	(0.634326)	(0.786155)	(0.749758)	(0.204967)	(1.622022)	(0.508627)	(0.38808)	(1.917791)	(1.311271)	(0.943962)	
South	-0.362646	-1.344831**	2.350018***	-0.878168	0.046207	0.801865	-1.158697***	-0.475059	-0.803184	0.093213	1.297021	0.1538
	(1.012324)	(0.533247)	(0.660882)	(0.630284)	(0.172305)	(1.363553)	(0.427577)	(0.32624)	(1.612191)	(1.10232)	(0.793542)	
Rural	-1.397994***	-0.282359	-0.571926*	0.317683	-0.06309	2.156006***	-0.47253**	-0.084468	-0.282372	0.001287	0.500987	0.2590
	(0.523303)	(0.275652)	(0.341631)	(0.325814)	(0.08907)	(0.704865)	(0.221028)	(0.168644)	(0.833394)	(0.569825)	(0.410208)	
R-squared	0.0433	-0.0026	0.1126	0.0593	0.1375	0.0449	0.1366	0.0658	0.2258	0.0502	0.0606	
Number of households	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112	1112

[1] Standard error in parentheses

[2] *** Significant at 1%
** Significant at 5%
* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix B 3. QUAIDS Engel curve (1.17) for households with others, no kids (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	-25.61885	27.31265	1.854806	26.06031*	0.337827	-102.6561*	2.80779	-28.20247	234.9178***	-34.78545	-23.81864	
	(56.82421)	(21.66995)	(28.1551)	(14.6156)	(9.015585)	(52.61389)	(34.25972)	(17.70175)	(58.21718)	(47.18976)	(35.84237)	
Household size	-0.879125	0.055263	-0.158361	0.376621	-0.176773	-1.268152	0.564737	-0.226353	1.983536**	0.7106	-1.004357*	3.4076
	(0.898599)	(0.342681)	(0.445235)	(0.231126)	(0.142569)	(0.832018)	(0.541772)	(0.279929)	(0.920626)	(0.746243)	(0.566799)	
Home owner	3.554106***	-0.13795	-0.620215	0.182236	0.410301*	-1.895847	-0.191142	-0.394512	0.155219	-0.410918	0.366698	0.7994
	(1.377573)	(0.525339)	(0.682556)	(0.354322)	(0.218562)	(1.275504)	(0.830549)	(0.429139)	(1.411343)	(1.144008)	(0.868917)	
Vehicle owner	-0.031124	-0.352592	0.018355	0.142497	-0.573504*	4.881945***	-2.031213*	0.744151	0.644433	-1.98897	-0.221118	0.9204
	(1.959949)	(0.747428)	(0.97111)	(0.504113)	(0.310961)	(1.814729)	(1.181668)	(0.610559)	(2.007995)	(1.627643)	(1.236255)	
Husband age	-0.009907	0.04264	-0.040605	0.022828	-0.022877	0.126396	0.000089	0.001947	-0.01089	0.019513	-0.102483	47.3567
	(0.112614)	(0.042945)	(0.055797)	(0.028965)	(0.017867)	(0.10427)	(0.067896)	(0.035081)	(0.115374)	(0.09352)	(0.071032)	
Wife age	-0.099643	-0.059018	0.020686	-0.058775*	0.009895	-0.225877**	0.045189	0.023392	0.179737	-0.02761	0.062514	45.2580
	(0.123587)	(0.04713)	(0.061234)	(0.031787)	(0.019608)	(0.11443)	(0.074511)	(0.038499)	(0.126616)	(0.102633)	(0.077953)	
Husband education (year)	0.231971	-0.046622	-0.154873	0.054145	-0.057776*	0.199243	0.102694	-0.040897	0.025793	0.008118	-0.315493**	11.9841
	(0.216644)	(0.082617)	(0.107342)	(0.055723)	(0.034372)	(0.200592)	(0.130616)	(0.067489)	(0.221955)	(0.179913)	(0.13665)	
Wife education (year)	-0.295399	0.079593	0.108263	0.039726	0.058939*	-0.167527	-0.351513***	0.000085	0.210372	0.100814	-0.046089	11.9172
	(0.222477)	(0.084842)	(0.110232)	(0.057223)	(0.035298)	(0.205993)	(0.134133)	(0.069306)	(0.227931)	(0.184756)	(0.140329)	
Log (husband wages)	-4.738013***	0.206653	1.591681*	-0.120773	0.187742	1.197689	1.007742	-0.514328	2.09115	-1.149982	-0.554111	4.9861
	(1.751813)	(0.668055)	(0.867984)	(0.450579)	(0.277938)	(1.622015)	(1.056181)	(0.545721)	(1.794757)	(1.454796)	(1.104972)	
Log (wife wages)	-0.415576	0.836533	1.211682*	0.214957	0.220527	2.415432*	-0.894615	0.837718*	-0.35681	-1.590978	-2.001522**	4.7709
	(1.430123)	(0.545378)	(0.708593)	(0.367838)	(0.2269)	(1.32416)	(0.862231)	(0.445509)	(1.465181)	(1.187648)	(0.902063)	
Log (household total consumption)	21.58927	-6.894372	-2.777329	-8.376433	0.138361	36.72306*	-3.22489	9.905021	-71.77256***	21.61752	12.73711	5.3622
	(21.57862)	(8.229019)	(10.69171)	(5.550177)	(3.423608)	(19.97977)	(13.0099)	(6.72212)	(22.10759)	(17.92)	(13.6109)	
Log (hh total consumption) squared	-1.278054	0.460972	0.127334	0.714234	-0.030262	-3.017101*	0.657454	-0.826341	5.048543***	-1.979624	-0.72757	29.1275
	(1.917996)	(0.731429)	(0.950324)	(0.493323)	(0.304304)	(1.775885)	(1.156374)	(0.59749)	(1.965013)	(1.592803)	(1.209793)	
Central	-5.144769**	-0.803852	1.601529	0.104703	-0.085461	3.561109	-0.479043	0.149204	-1.773634	0.980238	2.161044	0.3854
	(2.386291)	(0.910014)	(1.182353)	(0.613772)	(0.378603)	(2.209482)	(1.438712)	(0.743372)	(2.444788)	(1.981699)	(1.505174)	
North	-6.279053**	-0.635105	1.591262	-0.412086	-0.002109	2.632052	1.6958	0.064322	0.003903	-0.759049	1.380445	0.2038
	(2.919854)	(1.113488)	(1.446721)	(0.751008)	(0.463257)	(2.703511)	(1.760401)	(0.909586)	(2.99143)	(2.424797)	(1.841723)	
Northeast	-4.827132	-1.275695	2.765194*	-0.365332	0.411625	4.40822	-0.400069	-0.265728	-1.706248	-2.419498	4.57288**	0.2420
	(3.39181)	(1.293469)	(1.680565)	(0.872398)	(0.538136)	(3.140498)	(2.044947)	(1.056609)	(3.474956)	(2.816734)	(2.139414)	
South	-5.636813*	-1.426474	2.534088*	-0.765105	0.078881	2.282409	1.429972	-0.534617	0.005731	-0.656034	2.328051	0.0828
	(2.906495)	(1.108394)	(1.440102)	(0.747572)	(0.461137)	(2.691142)	(1.752347)	(0.905425)	(2.977744)	(2.413703)	(1.833297)	
Rural	-0.435998	-0.780954	0.461764	-0.103289	-0.070692	1.125143	0.437793	0.459218	-0.954762	-0.744665	0.562215	0.2293
	(1.315775)	(0.501772)	(0.651937)	(0.338427)	(0.208758)	(1.218285)	(0.793291)	(0.409887)	(1.34803)	(1.092688)	(0.829937)	
R-squared	-0.0051	0.0757	0.0953	0.0721	0.0904	0.3138	0.1446	0.0993	0.3112	0.1049	0.0627	
Number of households	314	314	314	314	314	314	314	314	314	314	314	314

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix B 4. QUAIDS Engel curve (1.17) for households with kids and others (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	6.154422	52.37576**	42.58459	8.230505	-1.679992	-117.9231***	17.79944	-12.07322	155.8969***	-15.44152	29.24307	
	(45.0715)	(22.608)	(29.01921)	(13.97275)	(5.321528)	(39.73806)	(22.03483)	(10.14506)	(47.49944)	(39.8893)	(28.1744)	
Household size	-0.302238	1.173707***	-0.628418	-0.168187	0.019659	0.561311	-0.048437	-0.23134	0.581497	-0.901002	-0.238985	4.5639
	(0.847523)	(0.42512)	(0.545676)	(0.262743)	(0.100066)	(0.747233)	(0.414342)	(0.190767)	(0.893178)	(0.750077)	(0.52979)	
Young children	0.096747	-0.686081	0.193675	0.091406	-0.207596	-2.121443*	-0.739852	-0.003654	3.126523**	-0.064005	0.223617	0.3333
	(1.289449)	(0.646792)	(0.83021)	(0.399746)	(0.152244)	(1.136865)	(0.630394)	(0.29024)	(1.35891)	(1.141192)	(0.806041)	
Older children	-1.542526	-1.118562**	1.419133**	-0.22354	-0.189808	-1.529427	0.762584	0.138498	0.597157	1.369963	0.13622	1.0251
	(1.098359)	(0.55094)	(0.707176)	(0.340506)	(0.129682)	(0.968387)	(0.536972)	(0.247228)	(1.157526)	(0.972073)	(0.686589)	
Home owner	2.119038**	-0.361523	-0.083377	0.006043	-0.013365	1.55324*	-0.746568	0.071009	-1.968085*	0.52613	-0.767593	0.7820
	(0.985143)	(0.494151)	(0.634283)	(0.305407)	(0.116314)	(0.868568)	(0.481623)	(0.221744)	(1.038211)	(0.871874)	(0.615817)	
Vehicle owner	-0.585685	-2.517305***	-0.289907	-0.145054	0.027266	5.32202***	0.307071	0.005513	-2.59831	-0.537942	0.044418	0.9223
	(1.633865)	(0.819552)	(1.051961)	(0.50652)	(0.192908)	(1.440525)	(0.798774)	(0.367764)	(1.721879)	(1.446008)	(1.021337)	
Husband age	0.22776**	-0.033635	0.04533	0.025057	0.013872	-0.095664	-0.011706	0.017866	-0.036805	-0.053534	-0.125662**	42.3008
	(0.102027)	(0.051177)	(0.06569)	(0.03163)	(0.012046)	(0.089954)	(0.049879)	(0.022965)	(0.107523)	(0.090296)	(0.063777)	
Wife age	-0.196358*	-0.015125	-0.041338	-0.009825	-0.017337	0.032956	0.09491*	-0.02557	0.069082	0.031501	0.110437*	39.3158
	(0.103133)	(0.051732)	(0.066402)	(0.031973)	(0.012177)	(0.090929)	(0.05042)	(0.023214)	(0.108689)	(0.091275)	(0.064469)	
Husband education (year)	0.260119*	-0.004203	0.005595	-0.019722	0.013822	0.006629	-0.029764	-0.03423	-0.050316	-0.082893	-0.105425	11.1404
	(0.149186)	(0.074832)	(0.096053)	(0.04625)	(0.017614)	(0.131533)	(0.072935)	(0.03358)	(0.157223)	(0.132033)	(0.093257)	
Wife education (year)	-0.085892	0.004557	0.182914*	0.053392	0.011812	-0.062077	0.029294	-0.041624	-0.096115	0.009652	-0.030831	11.2682
	(0.157097)	(0.0788)	(0.101147)	(0.048702)	(0.018548)	(0.138507)	(0.076803)	(0.035361)	(0.16556)	(0.139035)	(0.098202)	
Log (husband wages)	-3.178818*	0.366119	-0.556715	-0.68275	-0.053828	4.963152***	-0.485016	0.220262	1.058018	-0.424701	1.370773	4.7618
	(1.751434)	(0.878525)	(1.127658)	(0.542968)	(0.206789)	(1.544182)	(0.856252)	(0.394227)	(1.845782)	(1.550059)	(1.09483)	
Log (wife wages)	-0.879336	0.344246	-0.244973	0.038585	-0.005282	2.071111*	-0.385821	0.382875	1.224267	-0.864015	-1.182051	4.4401
	(1.231024)	(0.617485)	(0.792593)	(0.381634)	(0.145345)	(1.085353)	(0.601831)	(0.277089)	(1.297338)	(1.089484)	(0.769519)	
Log (household total consumption)	4.435848	-17.79263**	-15.85204	-0.926077	0.600567	40.49643***	-7.934113	3.883188	-39.38447**	13.74927	-8.142981	5.1068
	(17.68147)	(8.869077)	(11.38418)	(5.481486)	(2.087625)	(15.58917)	(8.644225)	(3.979889)	(18.63394)	(15.6485)	(11.05277)	
Log (hh total consumption) squared	0.187568	1.615196*	1.646126	0.123951	-0.024055	-3.968796***	1.044202	-0.279865	2.317923	-1.176304	0.670519	26.3557
	(1.666983)	(0.836164)	(1.073284)	(0.516786)	(0.196818)	(1.469724)	(0.814965)	(0.375218)	(1.756781)	(1.475318)	(1.042039)	
Central	-2.00979	1.00081	1.330134	-0.329577	0.013426	-1.254699	-0.344413	0.833894**	2.620172	-1.247703	0.580655	0.3784
	(1.892014)	(0.94904)	(1.21817)	(0.586549)	(0.223387)	(1.668126)	(0.92498)	(0.42587)	(1.993934)	(1.674475)	(1.182707)	
North	-2.339502	1.558448	2.329148	0.154644	0.11663	-2.094627	0.433544	0.706575	3.848144	-3.416103*	0.154179	0.1779
	(2.254637)	(1.130933)	(1.451644)	(0.698967)	(0.266202)	(1.987839)	(1.102261)	(0.507492)	(2.376091)	(1.995405)	(1.409384)	
Northeast	-2.1175	1.062708	2.897623*	-0.050167	0.226563	-2.482786	-0.244444	0.540927	2.606285	-2.165421	1.172265	0.2506
	(2.31045)	(1.158928)	(1.487579)	(0.71627)	(0.272792)	(2.037047)	(1.129547)	(0.520055)	(2.43491)	(2.0448)	(1.444273)	
South	-2.839759	0.099553	2.985717**	-0.01329	-0.095353	-2.72452	-0.90589	0.153266	5.862242***	-2.217059	1.067441	0.1078
	(2.158616)	(1.082769)	(1.389821)	(0.669199)	(0.254865)	(1.903181)	(1.055318)	(0.485879)	(2.274898)	(1.910425)	(1.349361)	
Rural	0.262274	-0.278426	0.176892	-0.303672	0.000143	1.677691*	0.254999	-0.368004	-1.504496	0.587879	-0.575139	0.2431
	(1.054227)	(0.528804)	(0.678762)	(0.326824)	(0.124471)	(0.929478)	(0.515397)	(0.237294)	(1.111017)	(0.933015)	(0.659002)	
R-squared	-0.0222	0.1008	0.1071	0.0444	0.1001	0.3970	0.1127	0.1384	0.4394	0.0705	0.0714	
Number of households	399	399	399	399	399	399	399	399	399	399	399	399

1 Standard error in parentheses

2 *** Significant at 1%

** Significant at 5%

* Significant at 10%

3 Incomes and total consumption in 100 baht

4 Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix B 5. QUAIDS Engel curve (1.17) for households with one dependent (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	9.607692	42.48559***	-24.63638	26.89102**	-4.215899	-27.42558	-5.041132	6.376922	194.4819***	-93.11088***	-26.61102	
	(26.65131)	(11.31006)	(15.39001)	(13.60178)	(4.059494)	(26.77895)	(11.80278)	(7.700325)	(33.41395)	(25.62627)	(18.76658)	
Young children	-0.650086	-0.668379*	-0.031233	2.905046***	-0.098003	-3.275267***	-2.126959***	-0.342395	5.996606***	-1.782388**	0.149236	0.3191
	(0.913061)	(0.387477)	(0.527255)	(0.465991)	(0.139076)	(0.917434)	(0.404358)	(0.26381)	(1.144746)	(0.877944)	(0.642934)	
Older children	-0.275904	-1.116219***	0.07506	-0.035088	-0.087111	-0.424395	-0.210814	0.056562	1.198084	0.768925	0.662742	0.4350
	(0.74374)	(0.315622)	(0.429479)	(0.379576)	(0.113286)	(0.747302)	(0.329372)	(0.214888)	(0.932461)	(0.715135)	(0.523706)	
Home owner	2.686896***	0.093966	0.309029	-0.196694	0.116882	-0.760717	-0.077993	-0.316441*	0.324629	-0.659689	-1.208039***	0.5875
	(0.63678)	(0.270231)	(0.367714)	(0.324987)	(0.096994)	(0.639829)	(0.282004)	(0.183984)	(0.798359)	(0.612288)	(0.44839)	
Vehicle owner	-2.983845***	-0.17903	0.516733	0.233245	0.031362	4.097538***	0.156601	0.57099**	0.902666	-2.613578***	-0.444755	0.8913
	(1.010479)	(0.428819)	(0.583509)	(0.515709)	(0.153915)	(1.015319)	(0.4475)	(0.291956)	(1.266883)	(0.971615)	(0.711531)	
Husband age	0.05366	0.012515	-0.032657	0.013883	-0.002088	0.088324	-0.013996	0.014854	-0.10058	0.014975	-0.063126	40.2884
	(0.061877)	(0.026259)	(0.035732)	(0.03158)	(0.009425)	(0.062174)	(0.027403)	(0.017878)	(0.077578)	(0.059497)	(0.043571)	
Wife age	-0.073779	-0.013807	0.02437	-0.049091	-0.002155	-0.143486**	0.005945	0.015746	0.222764***	-0.042313	0.032864	37.8712
	(0.064889)	(0.027537)	(0.037471)	(0.033117)	(0.009884)	(0.0652)	(0.028737)	(0.018748)	(0.081354)	(0.062393)	(0.045692)	
Husband education (year)	0.070368	0.037633	0.10798*	0.029022	-0.01487	0.14611	0.016457	0.056547*	-0.198238	-0.129934	-0.095191	10.7742
	(0.108222)	(0.045927)	(0.062494)	(0.055233)	(0.016484)	(0.108741)	(0.047927)	(0.031269)	(0.135683)	(0.10406)	(0.076205)	
Wife education (year)	0.003556	0.002206	0.091314	0.066063	0.046268***	-0.007107	-0.092477*	-0.005442	0.065373	-0.053659	-0.227754***	10.8416
	(0.113857)	(0.048318)	(0.065748)	(0.058108)	(0.017343)	(0.114402)	(0.050423)	(0.032897)	(0.142747)	(0.109478)	(0.080173)	
Log (husband wages)	-3.090336***	1.416274***	1.502389***	-0.356497	0.240997	3.06232***	0.493707	-0.345091	1.12858	-2.412884**	-1.349154*	4.5944
	(1.090599)	(0.46282)	(0.629775)	(0.556599)	(0.166119)	(1.095823)	(0.482982)	(0.315105)	(1.367334)	(1.048654)	(0.767948)	
Log (wife wages)	-3.038903***	0.147012	0.352069	0.160246	0.164039	2.23176***	0.232867	0.011217	1.761983*	-0.808774	-0.921466	4.3593
	(0.844523)	(0.358392)	(0.487676)	(0.431011)	(0.128637)	(0.848567)	(0.374005)	(0.244007)	(1.058816)	(0.812041)	(0.594673)	
Log (household total consumption)	5.199436	-13.30208***	9.052442	-8.885799	1.327467	7.16444	1.43849	-3.561425	-55.05468***	44.33611***	12.98756*	4.9202
	(10.65526)	(4.521792)	(6.152967)	(5.438027)	(1.622996)	(10.70629)	(4.718783)	(3.07861)	(13.35898)	(10.24545)	(7.502928)	
Log (hh total consumption) squared	0.351113	0.967795**	-1.152427*	0.905914	-0.151051	-0.547099	-0.021741	0.506044	3.602141***	-3.838641***	-0.827672	24.5081
	(1.085655)	(0.460721)	(0.62692)	(0.554076)	(0.165366)	(1.090855)	(0.480793)	(0.313677)	(1.361135)	(1.0439)	(0.764467)	
Central	-0.582077	-0.092479	1.43887**	-0.791977	0.050652	-1.1552	-0.744492	0.418911	-0.969	-0.101907	3.053339***	0.3865
	(1.078839)	(0.457829)	(0.622984)	(0.550597)	(0.164327)	(1.084006)	(0.477774)	(0.311708)	(1.352589)	(1.037346)	(0.759667)	
North	0.19376	-0.515386	1.93606**	-1.04116	0.198178	-1.657388	0.081922	0.103423	-2.108153	0.026372	2.671003***	0.2092
	(1.436459)	(0.609593)	(0.829495)	(0.733112)	(0.2188)	(1.443338)	(0.636149)	(0.415034)	(1.800953)	(1.381211)	(1.011486)	
Northeast	0.394799	-0.690179	1.44015	-0.664091	0.060925	-1.115607	-1.624949**	0.562846	-1.721088	-0.345787	4.243144***	0.1631
	(1.620599)	(0.687736)	(0.935828)	(0.82709)	(0.246848)	(1.62836)	(0.717698)	(0.468237)	(2.031818)	(1.558269)	(1.141149)	
South	0.08295	-0.866827	2.071783***	-2.147145***	-0.00415	-1.444293	-0.055527	-0.160096	0.646891	0.234282	1.83598**	0.1312
	(1.31566)	(0.558329)	(0.759739)	(0.671461)	(0.2004)	(1.321961)	(0.582653)	(0.380132)	(1.649502)	(1.265058)	(0.926425)	
Rural	-1.313874*	-0.173014	-0.7284*	0.20093	-0.112757	1.409834**	0.04108	0.072367	-0.954475	1.010658	0.626047	0.2541
	(0.684084)	(0.290306)	(0.39503)	(0.34913)	(0.104199)	(0.68736)	(0.302953)	(0.197651)	(0.857667)	(0.657773)	(0.481699)	
R-squared	-0.0973	0.0723	0.0443	0.1556	0.0951	0.3401	0.1659	0.1589	0.3977	0.0870	0.0716	
Number of households	846	846	846	846	846	846	846	846	846	846	846	846

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix B 6. QUAIDS Engel curve (1.17) for households with two dependents (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	-25.94597	49.71399***	15.2075	5.842335	0.148954	-135.043***	11.21353	-0.034415	213.2955***	-62.0318**	19.11897	
	(31.14947)	(14.29068)	(18.82204)	(13.0403)	(4.172485)	(33.16421)	(14.17913)	(8.504395)	(41.75173)	(26.87952)	(20.35923)	
Young children	-0.213211	-0.062337	0.439968	1.550279***	-0.080883	-0.38795	-1.114623***	0.056878	1.669201*	-2.317174***	0.255049	0.3709
	(0.706221)	(0.323998)	(0.426734)	(0.29565)	(0.094599)	(0.7519)	(0.32147)	(0.192812)	(0.946596)	(0.609413)	(0.461585)	
Older children	-0.794166	-0.30794	0.720806**	0.179793	0.036415	0.750998	-0.486703**	-0.010308	0.283052	-0.747008*	0.567646*	1.0742
	(0.504697)	(0.231544)	(0.304963)	(0.211285)	(0.067604)	(0.537341)	(0.229737)	(0.137792)	(0.67648)	(0.435514)	(0.329869)	
Home owner	3.348566***	0.025581	-0.228717	-0.41986	-0.082249	0.258031	-0.379648	0.086162	-1.711844*	0.257495	-0.585396	0.6731
	(0.706059)	(0.323924)	(0.426636)	(0.295582)	(0.094577)	(0.751727)	(0.321396)	(0.192768)	(0.946378)	(0.609273)	(0.461479)	
Vehicle owner	0.031207	-0.377858	-0.226687	-0.49439	-0.011207	1.089079	-0.35629	0.666445**	2.847611*	-2.476033**	0.466059	0.9203
	(1.246085)	(0.571676)	(0.752946)	(0.521657)	(0.166914)	(1.326682)	(0.567214)	(0.340205)	(1.670212)	(1.075273)	(0.814439)	
Husband age	0.064447	-0.022606	0.008764	0.009031	0.001189	-0.015922	-0.025621	0.029907	-0.005541	-0.022428	0.004433	40.9560
	(0.072918)	(0.033453)	(0.044061)	(0.030526)	(0.009767)	(0.077634)	(0.033192)	(0.019908)	(0.097737)	(0.062922)	(0.047659)	
Wife age	-0.085666	0.034745	-0.029967	-0.007361	-0.012654	-0.016783	0.12452***	-0.001184	0.051942	-0.037143	0.014681	38.2967
	(0.079126)	(0.036301)	(0.047812)	(0.033125)	(0.010599)	(0.084244)	(0.036018)	(0.021603)	(0.106058)	(0.06828)	(0.051717)	
Husband education (year)	0.108976	0.048025	0.014582	-0.10668**	0.015411	0.12397	0.011195	-0.007249	0.021591	-0.140033	-0.024609	11.0783
	(0.122796)	(0.056336)	(0.074199)	(0.051407)	(0.016449)	(0.130738)	(0.055896)	(0.033526)	(0.164592)	(0.105963)	(0.080259)	
Wife education (year)	-0.229022*	0.074249	0.081762	0.017556	0.005584	0.051034	0.004308	0.027523	0.042435	0.091117	-0.149014*	11.1635
	(0.128698)	(0.059044)	(0.077766)	(0.053878)	(0.017239)	(0.137022)	(0.058583)	(0.035137)	(0.172503)	(0.111056)	(0.084117)	
Log (husband wages)	-3.683913**	0.172662	-0.254161	-1.459282**	0.049629	-1.540365	-0.04397	0.640743	6.97923***	0.080463	0.56298	4.7127
	(1.71899)	(0.788634)	(1.038698)	(0.719632)	(0.230259)	(1.830174)	(0.782478)	(0.469317)	(2.304077)	(1.483352)	(1.123528)	
Log (wife wages)	-1.205059	0.528851	-0.678645	-0.244235	0.090925	-1.037598	-0.862611*	0.321761	2.933841**	0.333003	-0.104787	4.4034
	(1.04392)	(0.478927)	(0.630788)	(0.437023)	(0.139834)	(1.111441)	(0.475189)	(0.28501)	(1.399236)	(0.90082)	(0.682304)	
Log (household total consumption)	17.54364	-14.95976***	-6.457366	-1.320407	-0.241456	51.16108***	-4.540637	-1.305593	-63.26694***	32.09322***	-6.294794	5.0507
	(12.15356)	(5.575778)	(7.343777)	(5.087921)	(1.627974)	(12.93965)	(5.532258)	(3.318151)	(16.29023)	(10.48755)	(7.943538)	
Log (hh total consumption) squared	-0.889276	1.146844**	0.883368	0.492247	0.051401	-3.751024***	0.697244	0.070604	3.343394**	-3.213066***	0.529381	25.8142
	(1.15417)	(0.529507)	(0.697406)	(0.483177)	(0.154602)	(1.228821)	(0.525374)	(0.31511)	(1.547011)	(0.995957)	(0.754363)	
Central	-2.524624**	-0.341107	1.810907**	0.268513	-0.02521	0.370177	-0.980737*	0.446319	-0.003882	-0.310451	0.762328	0.3819
	(1.260757)	(0.578407)	(0.761812)	(0.527799)	(0.168879)	(1.342303)	(0.573892)	(0.344211)	(1.689878)	(1.087933)	(0.824028)	
North	-2.198517	-0.583303	2.972044***	1.007097	0.026419	1.502531	-0.664532	0.393025	-2.605829	-2.095037	0.963203	0.1676
	(1.855929)	(0.851458)	(1.121443)	(0.776959)	(0.248602)	(1.97597)	(0.844813)	(0.506704)	(2.487626)	(1.601519)	(1.213031)	
Northeast	-1.904761	-1.18679	2.159979**	1.665501**	0.202605	1.303717	-1.642774**	-0.328103	-0.991387	-2.044136	1.481256	0.2294
	(1.777856)	(0.81564)	(1.074268)	(0.744275)	(0.238145)	(1.892848)	(0.809274)	(0.485388)	(2.38298)	(1.534149)	(1.162003)	
South	-1.346234	-1.017177	2.491754**	1.275628*	-0.045127	0.437815	-1.319636*	-0.127008	-0.493286	-1.58082	0.688144	0.1277
	(1.614045)	(0.740488)	(0.975286)	(0.675698)	(0.216202)	(1.718442)	(0.734708)	(0.440665)	(2.163413)	(1.392793)	(1.054937)	
Rural	-0.113413	-0.254093	0.131249	0.02186	-0.065041	2.481049***	-0.343108	-0.179432	-1.059636	-1.456804**	0.076254	0.2473
	(0.787828)	(0.361438)	(0.476044)	(0.329813)	(0.10553)	(0.838784)	(0.358617)	(0.215092)	(1.055979)	(0.679833)	(0.514923)	
R-squared	-0.0765	0.0908	0.0857	0.0051	0.1033	0.1879	0.1484	0.0680	0.1792	0.0817	0.0322	
Number of households	728	728	728	728	728	728	728	728	728	728	728	728

[1] Standard error in parentheses

[2] *** Significant at 1%
 ** Significant at 5%
 * Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

Appendix B 7. QUAIDS Engel curve (1.17) for households with three or more dependents (3SLS)

Variable	Housing	Household operations	Clothing& Footwear	Personal& Services	Cosmetic	Transportation& Communication	Education	Recreation& Religion	Food in	Food out	Alcohol& Tobacco	Mean of X
Constant	15.77136	81.18375***	8.541248	27.17966*	13.23764	-138.5017***	-6.047831	-5.162412	133.8621***	-12.03124	25.07067	
	(38.30264)	(25.21963)	(28.22445)	(15.38049)	(8.116318)	(48.1543)	(21.84644)	(11.00513)	(49.81215)	(41.55579)	(29.31194)	
Young children	0.400745	-0.244075	-0.432096	1.095245***	-0.122134	-0.524346	-0.647989	-0.167854	2.66877***	-1.691292**	-0.534337	0.5657
	(0.764659)	(0.503475)	(0.563462)	(0.30705)	(0.162031)	(0.961334)	(0.436134)	(0.219702)	(0.994431)	(0.829604)	(0.585172)	
Older children	-0.81359	-0.43458	0.559276	0.167172	0.103497	-1.387835**	0.539723*	-0.023013	1.290989**	-0.085951	-0.239318	1.4502
	(0.50029)	(0.329406)	(0.368654)	(0.200892)	(0.106011)	(0.628968)	(0.285348)	(0.143744)	(0.650622)	(0.542781)	(0.382858)	
Home owner	1.424702	-0.099615	-0.641984	-0.322673	0.039175	-0.517948	-0.392559	0.244262	1.117606	-0.247919	-0.555687	0.7689
	(1.064019)	(0.700583)	(0.784055)	(0.427259)	(0.225465)	(1.337691)	(0.606878)	(0.305715)	(1.383745)	(1.154389)	(0.814264)	
Vehicle owner	0.78019	-0.36346	-0.001734	-0.025579	-0.015086	5.077748***	0.885314	-0.011693	-4.539312**	-1.831275	-0.77943	0.9084
	(1.562153)	(1.028569)	(1.151119)	(0.627285)	(0.33102)	(1.963948)	(0.890996)	(0.448839)	(2.031563)	(1.694831)	(1.195472)	
Husband age	0.186726*	0.025066	-0.001481	0.027991	-0.002121	0.118289	0.055489	0.016806	-0.054954	-0.240907**	-0.130097	41.5538
	(0.106681)	(0.070242)	(0.078611)	(0.042838)	(0.022606)	(0.13412)	(0.060847)	(0.030652)	(0.138737)	(0.115742)	(0.08164)	
Wife age	-0.116002	-0.028767	0.012862	-0.001871	-0.001064	-0.087166	0.006489	0.017053	0.1245	0.002865	0.065872	38.6056
	(0.106153)	(0.069894)	(0.078222)	(0.042626)	(0.022494)	(0.133456)	(0.060546)	(0.0305)	(0.13805)	(0.115169)	(0.081236)	
Husband education (year)	0.279775	0.200276*	-0.108136	0.198217***	-0.018589	-0.230572	-0.015136	0.002345	0.160709	-0.198827	-0.216991	11.2709
	(0.183628)	(0.120906)	(0.135312)	(0.073736)	(0.038911)	(0.230858)	(0.104735)	(0.05276)	(0.238806)	(0.199224)	(0.140525)	
Wife education (year)	0.008724	0.072251	0.211039	-0.071231	0.053748	-0.169032	0.081032	-0.067921	0.05682	-0.401596**	0.129607	11.0757
	(0.174754)	(0.115063)	(0.128773)	(0.070173)	(0.03703)	(0.219702)	(0.099673)	(0.05021)	(0.227266)	(0.189596)	(0.133734)	
Log (husband wages)	1.515908	2.678484**	0.63914	-0.802076	0.061384	-2.84259	-0.577179	-0.122318	-1.308198	0.686964	1.788219	4.7307
	(1.883489)	(1.240147)	(1.387906)	(0.756318)	(0.399111)	(2.367934)	(1.074274)	(0.541165)	(2.449456)	(2.043459)	(1.441381)	
Log (wife wages)	-0.87907	0.396308	0.613029	-0.559713	-0.072017	-0.413933	0.544776	0.234969	1.19069	1.171174	-1.456643	4.4432
	(1.336922)	(0.88027)	(0.985151)	(0.536843)	(0.283293)	(1.680786)	(0.762532)	(0.384125)	(1.738652)	(1.45047)	(1.023109)	
Log (household total consumption)	1.352251	-26.6478***	-4.802379	-9.249888	-5.507976*	47.2751***	1.017305	0.906227	-28.50187	12.58707	-5.980221	5.1458
	(14.12661)	(9.301389)	(10.40962)	(5.672563)	(2.993424)	(17.76005)	(8.057307)	(4.058864)	(18.37149)	(15.32642)	(10.8107)	
Log (hh total consumption) squared	-0.517995	1.846468**	0.405958	1.054898**	0.569407**	-2.784879**	0.034127	0.023992	1.371464	-1.135999	0.439075	26.8081
	(1.106385)	(0.728478)	(0.815273)	(0.444271)	(0.234443)	(1.390954)	(0.631042)	(0.317887)	(1.438842)	(1.200354)	(0.846686)	
Central	-3.904303**	-1.595942	1.351703	-1.169132	0.027269	3.696976	-0.66748	0.376145	0.565551	0.943597	0.596051	0.3506
	(1.925625)	(1.26789)	(1.418954)	(0.773238)	(0.408039)	(2.420907)	(1.098307)	(0.553272)	(2.504253)	(2.089173)	(1.473627)	
North	-6.576808***	-0.554597	2.524154*	-0.897474	0.289907	3.652183	0.81471	0.450233	2.089998	-1.572364	0.296778	0.1753
	(2.054854)	(1.352978)	(1.51418)	(0.82513)	(0.435423)	(2.583374)	(1.172014)	(0.590402)	(2.672314)	(2.229378)	(1.572522)	
Northeast	-6.073314***	-2.208436	1.958462	-1.438814	0.241443	4.790483*	-0.253686	0.372811	1.173693	1.249037	1.316281	0.2351
	(2.291469)	(1.508773)	(1.688538)	(0.920143)	(0.485562)	(2.880848)	(1.306971)	(0.658386)	(2.980029)	(2.486089)	(1.753597)	
South	-5.140622**	-1.379728	3.416182**	-1.65932*	-0.051889	3.105499	-0.296188	-0.410637	2.896793	-1.748459	1.65897	0.1434
	(2.138454)	(1.408024)	(1.575784)	(0.8587)	(0.453138)	(2.688477)	(1.219697)	(0.614422)	(2.781036)	(2.320079)	(1.636499)	
Rural	-0.969292	-1.839902***	0.599857	0.217152	0.038627	2.242472*	0.064928	0.102582	0.226156	0.659704	-0.575612	0.2470
	(1.085604)	(0.714795)	(0.79996)	(0.435926)	(0.230039)	(1.364828)	(0.61919)	(0.311916)	(1.411816)	(1.177808)	(0.830783)	
R-squared	0.1121	-0.0914	0.0906	0.2152	0.1437	0.1795	0.1713	0.1801	0.4743	0.1284	0.0565	
Number of households	251	251	251	251	251	251	251	251	251	251	251	251

[1] Standard error in parentheses

[2] *** Significant at 1%

** Significant at 5%

* Significant at 10%

[3] Incomes and total consumption in 100 baht

[4] Dummy variables - Bangkok dummy equals zero; Urban dummy equals zero

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