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A Comparison of Unitary and Collective Household Models to estimate Labour Supply in Austria

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1 Introduction

This paper describes ways to estimate labour supply in Austria theoretically but also empirically using EU-SILC data 2004-2006 from Statistik Austria.
In general there are two main approaches that will be discussed in detail in this work. One is the unitary model whose main characteristic is that it perceives the household as one decision-making unit. Practically this means that the household has only one utility function that needs to be maximized. In order to use that specification the income-pooling hypothesis has to be made. It states that the source of income does not influence the consumption and labour supply choices of a household. Handling a multi-person household as one decision-making unit is clearly handy however with simplifications come shortcomings. Clear downsides are that no changes on an individual level can be observed.
The second model, the collective model, is superior from a microeconomic perspective in that sense that it perceives the household as a group of individuals each with her/his own preferences. The main assumption is a pareto-efficient distribution of allocations.[1] This model does not treat the household as a black box and is thus very appropriate to study changes in the labour supply of individuals. For example in case one expects a policy to influence one partner more than the other, the collective model will in most cases be the preferred choice. We will find out in the applied part of the paper that this more realistic model will come at the price of difficulties in the estimation procedure.

These two models will be used to explain discrete labour supply choices of multi-person households. The discrete hours approach allows us to instead of considering a continuous spectrum of choices, limit them to four working hours categories. These will be not working, working 20, 40 and 60 hours per week. This is more realistic than continuous choices since employers are not totally flexible but offer options such as part- and full time contracts.
The preferences of children will not be considered. This is more relevant in the collective setting since it accounts for individual preferences. It would however simply be beyond the scope of this paper to estimate power shares and to create utility functions according to number and age of children in the household. Therefore, only two household leaders (couple) will be considered in the collective utility function and children will be used as explanatory variables. Moreover estimations by household type[2] are carried out in both the collective and the unitary model. This is done

[1] An allocation is said to be pareto-efficient among all possible choices (over leisure and consumption which satisfy the budget constraint) if one individual's welfare can not be increased without decreasing the welfare of the other.

[2] The household types indicates the number of children which are categorized as 0, 1, 2, or more than 2.

to understand if different household types call for specific utility functions.
Both models are based on the simple static labour supply model. Depending on the household (in case of the unitary model) or on the individual preferences (in case of the collective model) the indifference curves[3] are defined. Their shape is determined by the utility function used.
All income related variables such as wages, non-labour incomes, taxes and benefits define the budget constraints. Combined the indifference curves and the budget constraint define the utility maximizing problem.
For both specifications (so either for the household or for the individual) two different utility functions were used. These are the quadratic and the translog utility function. The quadratic function, as the name suggests, uses squared variables while the translog model is based on logarithmised variables. These are two of the most commonly used models and were thus included to compare their applicability in this context.
Their estimation on a household scale is exactly what the unitary model does.
The collective model requires some more estimation steps since the household has to be split into individuals. To do so the first step is to divide the incomes between the partners. The researcher can define this so called sharing rule. Typical variables used to calculate the shares are wages and earning potential. Knowing these shares, the budget constraint of each household member can be derived. The indifference curves, originating from the utility specification, allow us to obtain the utility maximizing working hours. The maximizing utilities of both partners are weighted by the bargaining power (share) wherefrom a household utility is derived.

To see which model is most suitable for Austria the European Union Statistics on Income and Living Conditions (from now on referred as EU-SILC) from 2004-2006 provided by Statistik Austria have been used. This data contains information about economic and sociographic variables, which allow studies on various topics such as housing, labour, health, pensions and education. The survey is conducted on a yearly basis. Additionally every year one target research topic (module) is issued. In 2010 this module will be *Intra-household sharing of resources*. This will allow advanced studies of the collective model as more specific data addressing intra-household distributions will be collected.
A first look at the data already allows us to obtain some interesting results. Low educated women earn less and seem to have a much more elastic working behaviour than men. The working hours choices of women seem to strongly depend on the household type, while male ones seem to be independent of the number of children. This observation leads us to fix men to their actual choice and only consider the

[3]Indifference curves describe all combinations of leisure and income that result in the same utility.

women's choice in the collective model as one special case.

Apart from the data, information about the Austrian tax-transfer system were used to construct a calculator that allows us to determine from a set of characteristics how much taxes and benefits people pay respectively receive. This set includes information on the marital status, the number and age of children, region, employment situation and many other variables. This calculator is a central part of this work since the amount subtracted and added to the gross income clearly affects the labour supply choice.

The appropriate estimation method is the maximum likelihood one. Specifically the conditional logit model, that next to individual specific variables (i.e. age, number of children) allows for alternative specific differences (i.e. income depending on working hours), will be used. As will be explained, the estimation outcomes are a probability distribution over utilities for each choice. If the working hours choices that are actually chosen equal the choice that is utility maximizing with the highest probability (as predicted) in many cases, the fit of the model is good. In case of the unitary model, the two utility specifications (translog and quadratic) will be compared according to fit statistics to see which of these fits better within the unitary setting.

In the empirical part of this paper we will have to realize that for the unitary model the income-pooling hypothesis cannot be supported by the Austrian EU-SILC data. This result on its own questions the validity of all the estimation results of the unitary model. If we neglect this finding for a second we find that the translog model seems to have a higher fit than the quadratic one. It shows, as we would expect that consumption and leisure have a positive influence on the utility of the household. More interestingly an increased appreciation of women for leisure is found with many young kids in the household. Moreover leisure time seems to be valued higher with age.

For the collective model one approach that constructs the household decision from intermediate estimation results fails to lead to reasonable outcomes. Another approach, that is based on calibrations, first leads to unsatisfying results as it estimates the power share to be either 0 or 1. We find that this is due to the formation of the household utility function.

The grid search over a leisure interaction term of the partners does not show any influence on the results at all. This further leads us to rethink the construction of the combined utility.

Therefore another grid search has been executed to find the most appropriate way to sum up the individual utilities. With the maximizing functional form the highest fit so far has been obtained.

Labour supply models are a main tool of economists since they allow them to predict alterations in working behaviour due to policy changes. Models as the ones discussed in this paper help to foresee and prepare for shifts in the labour market. The modelling technique of simulating policies and analyzing their effects is called micro simulation.
This paper contributes to the understanding of the use of micro simulations, as it compares two main approaches and discusses their applicability and suitability for Austrian data.

2 Theoretical Discussion of Labour Supply Models

In this chapter both models are discussed in a purely theoretical way. This means that their development, properties and assumptions are sketched but no practical matter is looked into. Estimation strategies and specifications of utility functions will be addressed in later chapters.

2.1 Unitary Model

The unitary model considers the household, consisting of two members (a husband m and a wife f), as one decision-making unit with a single utility function to maximize and a set of stable and transitive preferences. The idea is based on the basic static individual labour supply model with the only difference that the individual is now a household. Individual preferences and demands of household members are neglected since only considered in aggregate. Furthermore the variables consumption, leisure and working hours should be understood as household measures. Moreover solely household income is examined independent of who contributes what share to it. Later practice can be justified under the assumption that the source of income does not influence the household's choices in matter of labour supply and consumption. This so-called income pooling assumption is a core feature of the unitary model. It is also testable and thereby serves as a mean to judge the validity and applicability of the model. This will be checked for the Austrian data used in a later chapter.
In the most basic unitary model the household's preferences are assumed to be defined over two types of goods, namely consumption goods c, and time spent outside the labour market (leisure) l_f and l_m. By arguments of the Hicks composite commodity theorem, the consumption goods can be treated as a single commodity since the group of prices move in parallel. Without loss of generality, the price of this commodity c can be set equal to 1. The preferences over consumption and leisure are formally represented in an utility function U that is twice continuously differentiable, increasing in its arguments and quasi-concave.
The total amount of time available per person is denoted as T and consists of the sum over the working hours (h_f, h_m) and leisure (l_f, l_m).
Apart from the income that is obtained by working at a deterministic and exogenous gross wage of w_f and w_m, the household may receive an after-tax non-labor income y. If we define $q = (c, l_f, l_m)'$ as the leisure and consumption bundle and $p = (1, w_f, w_m)'$ as the full price vector of the household, the maximization problem can be written as:

$$max_q \quad U(q)$$

$$\text{subject to} \quad p'q = c + l_f w_f + l_m w_m = y + w_f T + w_m T$$

The constraint, referred to as the full income constraint, arises from a combination of time and budget restrictions that are respectively, $T = h_i + l_i$ for $i = m, f$ and $c = y + w_f h_f + w_m h_m$.
The maximization of the above problem results in a set of differentiable Marshallian commodity and leisure demand (and implicitly labour supply) functions in the form of $q = g(y + w_f T + w_m T, p)$. These are due to the utility maximization restricted to fulfil the following observable restrictions:

- Adding up condition: $p'g(y + w_f T + w_m T, p) = y + w_f T + w_m T$
  This rather natural condition states that total demand equals total expenditure.

- Homogeneity of degree zero: $g(\lambda(y + w_f T + w_m T), \lambda p) = g(y + w_f T + w_m T, p)$ with $\lambda \in R_{++}$
  If all prices and the household's total income are multiplied by any number $\lambda > 0$, its budget set remains unchanged. And, since the set of bundles from which the household can choose is not changed, the same bundle should still be chosen.

- Symmetry of the Slutsky Matrix: $S = S'$ where $S = \frac{dg}{dp'} + \frac{dg}{d(y+w_f T+w_m T)q'}$
  The compensated cross price and cross wage effects are symmetric. Symmetry of latter excludes the possibility that l_f is a complement (substitute) for l_m while l_m is not a complement (substitute) for l_f.

- Slutsky Matrix is negative semi-definite: $x'Sx \leq 0$
  This requires the wage response of the compensated labour supply to be non-negative.

It has been shown by Hurwicz and Uzawa [12] that these four conditions are necessary as well as sufficient for the integrability, which guarantees that by integrating the demand functions the utility function can be recovered.

As mentioned this is a simple form of the unitary model. Other specifications explicitly include household production (see for example Hallberg [15]). This extension allows for better understanding of how non-market time is allocated between various time uses. In the above setting taxation has not been taken into account implicitly since wages and non-labour income were assumed to be after-tax already. When working with gross income the taxation system has to be modelled in order

to define the budget constraint as done by Beninger and Laisney [6].
Even though this model is well established and still frequently used in research it was proven to have its flaws. First of all the main idea that the household can be treated as a single decision making unit conflicts with the microeconomics' credo that individual behaviour should be the centre of attention.
Supporters of the unitary approach have used Becker's rotten kid argument stating that even if not every member of the household is altruistic, the non-altruistic members still have an incentive to maximize the household's income rather than their own. This holds however only under rather strong assumptions.[4] In older papers, like the 1965 paper by Kauder [17], the household's decision is assumed to coincide with that of a household leader. This perception of how a household reaches its decisions should however be out-dated.
In general the unitary model can be criticized in many ways due to its lack of theoretical foundations. For a more explicit discussion thereof see Chiappori [11].

Apart from the methodological controversy, the unitary model has an undeniable weakness when it comes to discussing welfare economics.
Since the household is treated as a black box, inequality, power allocations and other intra-group characteristics are ignored. These issues are however crucial when it comes to policymaking, for example when addressing issues like divorce laws. A critical view on that is presented by Apps and Rees [1].
Assumptions necessary for the unitary model to hold could not always find empirical support. First of all the hypothesis of income pooling has been rejected in several studies[5]. Besides the assumption of symmetry of the Slutsky matrix, which means that the marginal compensated wage changes of two individuals in a household have the same effect on each other's labour supply, has been rejected in some studies such as Kooreman's [19].

2.2 Collective Model

Due to the discussed deficits of the unitary model an alternative one, called the collective model, has been established. One of the most influential contributions was made by Chiappori [10] whose basic model will be the starting point of the following discussion.
In contrast to the unitary model, the collective model focuses on the decision process within the household. It allows for individual preferences inside a household and addresses power distribution. As in the unitary model one simplistically considers a

[4] Necessary assumptions are a specific decision process and a transferable utility function.
[5] Papers that reject this hypothesis have been published among others by Attanasio and Lechene [3], Thomas [23] and Phipps and Burton [21].

two-member household in a three-good economy (labour supply of both household members, (h_m, h_f) and consumption c). The total time available for each individual is again T and leisure is as before labelled by l_m and l_f.
The central assumption of the collective model is the pareto-efficiency of allocations. An allocation is said to be pareto-efficient among all possible choices (over leisure and consumption which satisfy the budget constraint) if one individual's welfare cannot be increased without decreasing the welfare of the other household's member. Chiappori and Browning [9] justify this assumption by arguing that one may interpret the decision-making process as a repeated game with perfect information about the other's preferences. This should allow the individuals to reach a pareto-efficient outcome. Furthermore the authors mention that the unitary model assumes households to maximize their utility, which can be generalized to pareto-efficiency. Thus the restriction is not less realistic than the one of maximizing utilities.
While Chiappori assumes pareto-efficiency, other authors model a concrete bargaining process, which may be cooperative or non-cooperative. Most of these bargaining rules assume pareto efficiency as well, which makes the Chiappori model a supergroup of more concrete specifications.
He distinguishes two types of households: those with egoistic and those with altruistic members.[6] Therefore the preferences of one individual might depend not only on one's own leisure and consumption but also on the partner's. According to Chiappori egoistic and altruistic preferences allow us to draw the same conclusions which justify focusing on either one of them.
Taking into account the pareto-efficiency assumption without specifying a concrete bargaining process, the maximization problem of member i takes the form

$$max_{c_i,l_i} \quad U_i(c_i, l_i)$$
$$\text{subject to} \quad U_{-i}(l_{-i}, c_{-i}) \geq U_{-i} \text{where } -i = m \text{ if } i = f \text{ and } -i = f \text{ if } i = m$$
$$\text{and} \quad (w_m + w_f)T + y \geq c_m + c_f + w_m l_m + w_f l_f$$

where U_{-i} is some required utility level of the partner that depends on wages and non-labour income. Household member i maximizes her/his utility taking into account the budget restriction and optimising in order to maintain a pre-allocated utility level of the partner.
An alternative representation follows from applying the second fundamental theorem of welfare economics, which states in its general form that out of the infinity of all possible pareto-efficient outcomes one can achieve any particular one by enacting

[6] The utility derived with respect to the other's consumption and leisure is 0 for the egoist and positive for the altruist.

a lump-sum wealth redistribution and then let the market take over.
In the labour supply context Chiappori explains household behaviour (still with linear budget restriction) in two stages using an explicit sharing rule for the unearned income. In the first stage the household members split the total non-labour income y.[7] The decision on how to split the whole amount is assumed to depend on wages and amount of non-labour income that the individual contribute initially. The parameter indicating the share is given for member m by $\mu_m = \mu(w_m, w_f, y_m, y_f)$ and thus for f by $\mu_f = y_m + y_f - \mu(w_m, w_f, y_m, y_f)$. It is possible to transfer nothing at all but also to give one's partner more than her/his non-labour income. In the second stage each member independently chooses consumption and labour supply subject to the corresponding budget constraint, which reads for egoistic preferences as

$$max_{c_i, l_i} \quad U_i(c_i, l_i)$$
$$\text{subject to} \quad w_i T + \mu_i(w_m, w_f, y_m, y_f) \geq c_i + w_i l_i \quad \forall i = f, m$$

The non-labour income weights can be understood to represent the amount of bargaining power a member has in the intra-household allocation process. The shares are not fixed but vary with changes in wages, non-labour income and prices. This again will affect labour supply and consumption. It follows that the source of income does matter, hence the income pooling hypothesis that is made in the unitary model does not hold. However the demand functions that are obtained as solutions to the maximization problem are still assumed to be continuously differentiable, homogeneous of degree 0 and adding up to full income.
Chiappori proves in one of his papers [11] that the two discussed representations are equivalent and the existence of a sharing rule implies that the collective decision process is efficient. In order to obtain the household allocation problem, the individual maximization problems can now be combined to

$$max_{c_f, c_m, l_f, l_m} \quad \mu_f(w_m, w_f, y, p) \quad U_f(c_f, l_f) + \mu_m(w_m, w_f, y, p) \quad U_m(c_m, l_m)$$
$$\text{subject to} \quad (w_m + w_f)T \geq c_m + c_f + w_m l_m + w_f l_f$$

As a household the aim is to maximize the (weighted) average of the individual preferences.
It should be noticed that shifts in the bargaining power caused by changes in wages, prices or non-labour income may affect household consumption and labour supply.

[7] It should be noticed, that in the applied part non-labour income will be replaced by consumption.

Since household preferences are no longer constant but depend on these variables it is not straightforward how to obtain a rational complete and transitive household preference ordering. The restrictions that could be imposed on the demand functions in the unitary model can no longer be assumed to hold. The Slutsky matrix will in general not be symmetric and negative semi-definite anymore since the utility function is now price and wage dependent (see Kalman, [16] and Pollak [22]).
Chiappori however derived in his 1988 paper similar non-parametric restrictions that also allow one to draw conclusions on integrability and uniqueness of the sharing rule in the collective setting. Specifically he requires the leisure demand (or labour supply) functions to fulfil some restrictions (similar to the Slutsky conditions) on a set of partial differential equations and inequalities.[8] These testable restrictions are sufficient to prove that the sharing rule can be uniquely defined up to an additive constant and allow identifying individual preferences. Therefore if the data seems to support the conditions, the collective model allows to draw conclusions on the intra-household decision making process and the individual preferences.[9]
A weakness of Chiappori's model is that it solely accounts for inner solutions to the problem and thereby excludes the possibility of non-participation in the labour market. More advanced models, among others by Vermeulen [25] and Blundell et al [7] allow for unemployment (by choice). The latter paper also introduces further refinements such as binary choices of males (work or not work) since data shows that a huge majority of all men work full time if they participate in the labour market.
Moreover Chiappori's setting does not consider the possibility of non-linear (convex) budget sets. This shortcoming has been addressed by Donni ([14]).
Household production called for further attention and found consideration in Apps and Rees ([2], [1]).

Next to pointing out the differences between unitary and collective models, it should be mentioned that in some special cases the former reduces to the latter. One such case is that both household members have identical preferences over leisure and consumption. Alternatively, if the household's preferences are indeed defined by the household leader, so that her/his bargaining power is 1, both models coincide. The same occurs if the bargaining power divide remains fixed between the members, then the household can be treated as an individual with separable preferences.

The above discussion focused on alterations that shift the bargaining power within the model parameters. Clearly the bargaining power can also be influenced by extra-

[8]Additionally one has to assume therefore that the demand functions are three times continuously differentiable and that μ is twice continuously differentiable.

[9]According to Chiappori [10] the same conclusion can be drawn under altruistic (caring) preferences.

household environmental parameters such as taxation and divorce laws.

In order to better understand how these models can be used, we will look at applications using data. This data will be discussed in the next section, before estimations are carried out.

3 Estimation of Labour Supply Models

In this section properties of labour supply models are described. First model assumptions and utility function properties are addressed that will hold for both specifications of households. Thereafter an appropriate estimation method, the maximum likelihood, specifically the conditional logit model, is introduced. This estimation method provides the theoretical base for the empirical conclusions in later sections. These general topics that apply to both models are followed by properties that are specific to the perception of a household. In the empirical estimation of the unitary and the collective model certain steps are required that will be discussed first, before they are estimated using data.
This chapter should support the understanding of labour supply models and thereby clarify the estimation procedures in later steps.

3.1 Static Labour Supply Model

In this subsection the static labour supply model will be sketched. It is the underlying basic theory of all labour supply model specifications that are discussed in this paper.

The labour supply model describes how every person decides on how to divide their limited time between working and leisure. Time spend on the labour market brings income that can be used for consumption, which in turn gives people satisfaction. Leisure in contrast does not create any income, it is however assumed to be associated with satisfaction as well.
For simplification we consider an individual that can work as much or as little as she/he wants at a certain wage without facing any fixed costs of working.
As the well-being is increasing in leisure and income, while the individual faces a time constraint, the same level of satisfaction can be obtained by various combinations of both. This level, in economic terms called utility, can be obtained by different shares of leisure and consumption. This trade-off is described by the so-called indifference curves. The slope of this curve tells us the amount of income one is willing to give up in order to spend one more hour not working. The absolute value of the slope, the marginal revenue, is decreasing in leisure. This means that the more leisure you already have, the less income you will give up to have more of it.

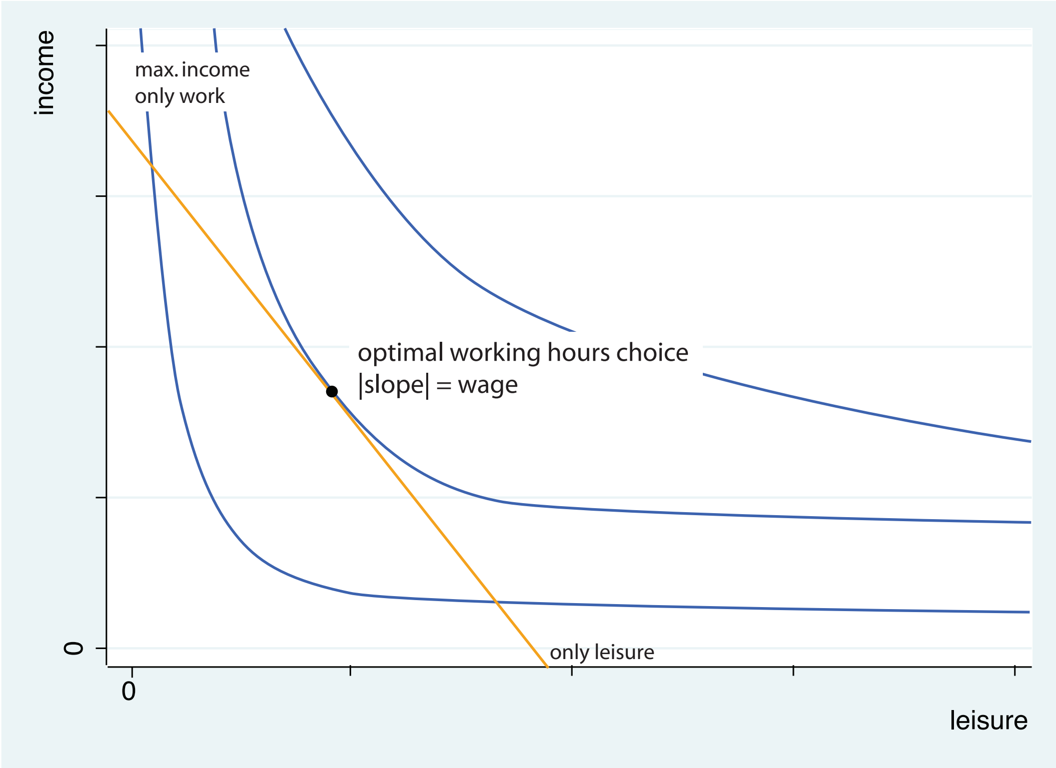

Figure 1: Static labour supply model

The more distant the indifference curve is from the origin the higher is the utility level along this curve.
In order to find the highest yieldable utility for a person we need to consider her/his budget constraint. This constraint is defined by wage, non-labour income and total time available. The intersection with the y-axis describes the highest possible income that is obtained if all the time available is spent on working. The intersection with the horizontal axis describes the maximum available time that can be spent on leisure only. All the other points along this line describe the possible leisure-working hours combinations that are feasible. Choices within the triangle are possible however inefficient while choices above the budget constraint are infeasible.
The optimal choice is thus made on a point on the budget constraint line where it touches an indifference curve. If the budget line would be a secant of the indifference curve, a higher curve could be reached that is more distant from the origin and guarantees a higher utility. Curves with a higher utility than the tangent one can not be reached under the budget constraint.
We can conclude that the utility maximizing working hours choice is given in the point where the slope of the indifference curve, the marginal rate of substitution, equals the ratio of the marginal utilities of leisure and income which is nothing else than the wage, which in turn is the slope of the budget constraint.
This basic setting can be easily extended to describe more realistic settings. For

example a non-labour income can be introduced that shifts the budget constraint up by the amount of extra money. Then corner solutions (in contrast to the tangency ones) are possible that explain why some peoples' optimal choice is to remain unemployed.
This setting allows us to consider effects of policies. If for examples wages decrease, the budget line will become less steep. It will intersect the vertical axis at a lower point (smaller maximum income) while the intersection with the horizontal axis will remain unchanged. This effect is known as the income effect. Since the amount of leisure one would give up for additional income changed as well[10] also another effect takes place, the so-called substitution effect.

This is the theoretical base for understanding working hours choice reactions of people (households in case of unitary model). In order to model them concretely, specific utility functions need to be assumed that define the shape of the indifference curves. Moreover necessary model assumptions need to be introduced as will be done in the following subsection.

3.2 Model Assumptions

For both the collective and unitary model, only information about households consisting of more than one person is of interest, as the aim is to compare multi-person household representations.
In both models discrete working hours are used. The advantage of the discrete approach is that it reflects the reality better, since workers can usually choose between few working hours options rather than having a continuous labour supply choice. Most often the choice is even more restricted to either working part- or full-time. Still, in order not to limit the choice set too much, four categories namely 0, 20, 40, 60 hours have been allowed. They are defined in such a way that choices between 0 to 10 count as 0; 10 to 25 as 20; 25 to 50 as 40 and everything above 50 as 60 hours. The discrete specification also found support in literature. For example Van Soest, Woittiez and Kepteyn [24] show that compared to the continuous specification the discrete one can significantly improve the representation of the actual labour supply. It is also important to mention that we disregard the demand side completely in this work. It is assumed that every individual can choose from the same set of working hours and the availability of these is assumed provided. Certainly labour market studies need to consider both sides. Micro simulations that model a policy are as well required to look into potential changes on the demand side and, based on both,

[10] Since the slope of the budget curve changed, the tangent with the indifference curve will not be parallel to the old one but will touch the curve in another angle now.

draw conclusions on the effect the policy might have on the labour market. As this paper is not aiming at fully portraying the labour market, only the representation of the supply side is studied.

Another strongly simplifying assumption made is that the hourly wage is independent from the choice of working hours. The calculated hourly wage that is obtained by the stated income and working hours[11] is thought as being constant for each subject. This is clearly not fully reflecting reality. Including wage differences according to the working hours choice would however go beyond the scope of this paper.

Children living in the household are not considered to have their own preferences. They are not directly included in the household utility function. The number of children and their age will however serve as an explanatory variable later on, which allows us to draw conclusions on how they influence their parents' labour supply choices and thus their utility. In case of the unitary model, preferences of kids are not relevant since the household is perceived as a single decision-making unit anyway. For the collective model various strategies could be considered of how to include children in the household structure. The sharing rule would need to be refined and a utility function for the child needs to be constructed.

Extending the collective model by age-dependent utility functions of children goes however beyond the scope of this paper.

As in most economic studies the utility maximizing assumption has to be made. Concretely all subjects are assumed to have chosen the working hours as stated, based on maximizing their utility in a perfectly rational way. Without this assumption the best (in sense of utility maximizing) working hours choice can not be observed, thus the data can not be used to understand choice as a utility maximizing behaviour.

3.3 Utility Function Properties

Theoretical Implementation: The first step required for estimation is to specify a utility function that explains labour supply behaviour. As utility is nothing that can be observed there is not one correct formula to compose the well being of an individual. Several specifications coexist in literature that certainly have to fulfil some indisputable properties of well-being. The utility should increase in leisure and consumption, and the marginal utility of both should be decreasing. Furthermore a term that captures trade-offs between leisure hours should be included. The resulting utility function should be quasi-concave in the observed labour supply.

[11] If no information was available the wages have been obtained from the Heckman procedure.

Econometric Utility Model: If we step back from the purely theoretical representation for a moment, we need to realize that in practice the determinants of anyone's behaviour can of course never be known with certainty. It is impossible to capture all the variables that may influence our working hours choice, which is respected by the econometric model (for individual i choosing j) in the following form

$$U^*_{i,j} = U(j|X_{i,j}) + \epsilon_{i,j} = U_{i,j} + \epsilon_{ij}$$

where U^* is the measured utility and ϵ is the error term that captures unobserved influences determining the choice but also measurement and optimization errors in the explanatory variables. The error terms are assumed to be independently and identically distributed and, as the model will be estimated by maximum likelihood, we need to assume a specific distribution of the ϵ terms. This assumption leads to the probability distribution over possible choices; therefore the result of maximum likelihood estimation will never be one clear resulting choice but a set of likelihoods that a certain decision will be taken.

3.4 Conditional Logit Model

The maximum likelihood estimation procedure is based on a likelihood function, which is similar to a probability function, with the difference that the parameters defining the function are not given but the outcome (observed data) is. Practically for every set of possible parameter values the likelihood function calculates how likely it is that one would observe the data that was actually observed if these values were the true population parameters.
In principal every model can be estimated by maximum likelihood approach. It turns out to be especially useful when dealing with discrete choice models as in case of our labour supply problem.
Depending on the assumed distribution of the error terms the multinomial[12] maximum likelihood estimation can be further classified. The two commonly assumed distributions are the normal one (the class of probit models) and the standard type I extreme value distribution (logit models). In the present context the logit model shows to be highly tractable and will therefore be used. In its standard versions the logit model uses individuals' characteristics to explain the dependent variable. If next to individual specific variables also alternative specific differences should be considered, the conditional logit model should be used. In this setting this means that not only characteristics like age, years of employment and other person related

[12]Distributions are called multinomial if more than two outcomes are possible.

data, but also variables that vary for each individual according to the alternative (working hours category), like available income[13], are used to explain the labour supply choice.
One downside of the conditional logit model is that it assumes no correlation between unobserved factors over alternatives. This property leads to strange substitutions between alternatives, called independence of irrelevant alternatives. An estimation technique that considers this problem is the mixed logit model. Mixed logit models not only allow the errors to display some randomness but also the coefficients, which represents randomness in the taste variation over people and correlation across alternatives. The reasons why the conditional logit model has been chosen for estimation anyway will be discussed in later sections when addressing concrete implementations and results.

As the conditional logit model will be the main estimation method used in this paper, its principles will now be introduced.
As before we suppose that the utility for individual i associated with choice j is

$$U_{ij} = X'_{ij}\beta + \epsilon_{ij}$$

The probability that subject i will choose alternative j, meaning that option j ($Y_i = j$) yields the highest level of utility, is $P_{ij} = P(max(U_{i,-j}, U_{ij})) = U_{ij}$ as derived by McFadden[20]. Since we assume that the error terms identically and individually follow a standard type I extreme value distribution with a cumulative density function of

$$F(\epsilon) = exp(-exp(-\epsilon))$$

and a corresponding probability density of

$$f(\epsilon) = exp(-\epsilon)exp(-exp(-\epsilon))$$

the probability that subject i chooses alternative j is

$$P_{i,j} = P(Y_i = j|X_{i,0}, ..., X_{i,J}) = \frac{exp(X'_{i,j}\beta)}{\sum_{l=0}^{J} exp(X'_{i,l}\beta)}$$

for $j = 0, ..., J$. This can easily be understood if we examine the probability that alternative 0 will be chosen. Choosing this option tells us that the utilities of working any positive amount (*work*) would be smaller than the utility of staying out of the

[13] The simulated available income at each labour hours choice is calculated considering alternative specific transfers and benefits.

labour market. Formally this means

$$U^*_{i,0} > U^*_{i,work} <=> X'_{i,0}\beta + \epsilon_{i,0} > X'_{i,work}\beta + \epsilon_{i,work} <=> \epsilon_{i,0} + X'_{i,0}\beta - X'_{i,work}\beta > \epsilon_{i,work}$$

Combining this result and the assumption that ϵ follows the distribution F as defined above, the probability that this happens is $F(\epsilon_{i,0} + X'_{i,0}\beta - X'_{i,work}\beta)$. The term $work$ represents of course the three categories of 20, 40 and 60 working hours and thus the probability that 0 is chosen should be calculated conditional on the case that all other utilities are smaller than $U^*_{i,0}$. Since we assume that the error terms are independently distributed we can multiply the CDFs to obtain the conditional probability. The CDFs are just the integrated PDFs with the integral boundaries of $-\infty$ to the argument of $F(.)$. These steps are recaptured in mathematical language as

$$\begin{aligned}
P(Y_i = 0|X_i) &= P(U^*_{i,0} > U^*_{i,20}, U^*_{i,0} > U^*_{i,40}, U^*_{i,0} > U^*_{i,60}) \\
&= P(\epsilon_{i,0} + X'_{i,0}\beta - X'_{i,20}\beta > \epsilon_{i,20}, ..., \epsilon_{i,0} + X'_{i,0}\beta - X'_{i,60}\beta > \epsilon_{i,60}) \\
&= \int_{-\infty}^{\infty}\int_{-\infty}^{b_{20}}\int_{-\infty}^{b_{40}}\int_{-\infty}^{b_{60}} f(\epsilon_{i,0})f(\epsilon_{i,20})f(\epsilon_{i,40})f(\epsilon_{i,60})d\epsilon_{i,0}d\epsilon_{i,20}d\epsilon_{i,40}d\epsilon_{i,60} \\
&= \int_{-\infty}^{\infty} exp(-\epsilon_{i,0})exp(-exp(-\epsilon_{i,0}))exp(-exp(-\epsilon_{i,0} - X'_{i,0}\beta + X'_{i,20}\beta))... \\
&\quad exp(-exp(-\epsilon_{i,0} - X'_{i,0}\beta + X'_{i,60}\beta))d\epsilon_{i,0} \\
&= \int_{-\infty}^{\infty} exp(-\epsilon_{i,0})exp[-exp(-\epsilon_{i,0}) - exp(-\epsilon_{i,0} - X'_{i,0}\beta + X'_{i,20}\beta))... \\
&\quad -exp(-\epsilon_{i,0} - X'_{i,0}\beta + X'_{i,60}\beta)]d\epsilon_{i,0} \\
&= \frac{exp(X'_{i,0}\beta)}{\sum_{j=0}^{J} exp(X'_{i,j}\beta)}
\end{aligned}$$

where $\epsilon_{i,0} + X'_{i,0}\beta - X'_{i,20}\beta = b_{20}$, $\epsilon_{i,0} + X'_{i,0}\beta - X'_{i,40}\beta = b_{40}$ and $\epsilon_{i,0} + X'_{i,0}\beta - X'_{i,60}\beta = b_{60}$. In exactly the same way the probability that 20, 40 and 60 working hours are chosen can be derived.

The likelihood function is not meant to represent one household only but should indicate the likelihood that each and every household takes a certain decision. This means that the likelihood function is the multiplication of $P(Y_i = hours|X_i)$ over all households $i = 1, ...I$: $\Pi_{i=1}^{I} \frac{exp(X'_{i,hours}\beta)}{\sum_{hours} exp(X'_{i,hours}\beta)}$. The log likelihood function for the conditional logit model can then be written as

$$\sum_{i=1}^{I}(\sum_{j=0}^{J} I(Y_i = j)X_{ij}\beta - ln(\sum_{j=0}^{J} exp(X_{ij}\beta)))$$

where $I(.)$ is an indicator function and as before $j \in 0, 20, 40, 60$ stands for the working hours choice and $i = 1, ...I$ identifies the subject. This is the function that will be maximized by solving the system of equations resulting from the derivatives of the log likelihood function with respect to the β. These solutions are most often not easy to obtain as they are non-linear functions and thus they are usually calculated numerically by statistic programs using optimization algorithms.[14] These start at an initial value and move in the direction of the parameter space that yields a higher likelihood value.

3.5 Specifics of the Unitary Model

Up till now only general remarks about labour supply estimations have been made that are valid for both, the unitary and the collective model. In this chapter the attention lies on specifics of the unitary model only. This implies that now we understand the household as a single decision-maker with a single utility function.
As already mentioned, utility functions need to fulfil several criteria, but the researcher still has the choice of specification. The most common specifications in the labour supply context are the quadratic and the translog ones. These two will be discussed shortly now.

Quadratic Utility Function: The quaratic utility function which has been used in studies as by Keane and Moffit [18] and Ducan and Giles [8] has the following form

$$U^* = \beta_c c + \beta_m l_m + \beta_f l_f + \beta_{cs} c^2 + \beta_{ms} l_m^2 + \beta_{fs} l_f^2 + \beta_{cf} c l_f + \beta_{cm} c l_m + \beta_{fm} l_f l_m + \beta_D D + \epsilon$$

where c is the household consumption and l_f and l_m are respectively the hours of leisure of the female and male part of the household. D includes variables containing information about the couple that may influence the working hours choice of both partners and their consumption behaviour. More specifically they are cross-terms of labour (or leisure), consumption, personal and household characteristics such as education, number and age of children, own age, province and more.
Diminishing returns of consumption and leisure are considered by the quadratic function with the marginal utility of income

$$\frac{\partial U}{\partial c} = \beta_c + 2\beta_{cs} c + \beta_{cl_f} l_f + \beta_{cl_m} l_m$$

and the marginal utility of male leisure of

$$\frac{\partial U}{\partial l_m} = \beta_m + 2\beta_{ms} l_m + \beta_{cm} c + \beta_{fm} l_f$$

[14] For example the iterative Newton method.

There is of course a complementary relationship between consumption and leisure since a higher consumption (more income) can only be obtained with more working hours and therefore less leisure.

Translog Utility Function: Another often-used function is the translog one which includes logarithmised variables

$$\begin{aligned} U^* &= \beta_c \, ln\, c + \beta_{l_m} \, ln\, l_m + \beta_{l_f} \, ln\, l_f + \beta_{cs} \, (ln\, c) = +\beta_{l_m s} \, (ln\, l_m) = \\ &+ \beta_{l_f s} \, (ln\, l_f) = +\beta_{cl_m} \, ln\, c\, ln\, l_m + \beta_{c l_f} \, ln\, c\, ln\, l_f + \beta_D \, D + \epsilon \end{aligned}$$

where the marginal utility of consumption is

$$\frac{\partial U}{\partial c} = \frac{\beta_c + 2\,\beta_{cs}\, ln\, c + \beta_{c\, l_m}\, ln\, l_m + \beta_{c\, l_f}\, ln\, l_f}{c}$$

and the derivative with respect to leisure of the male part is

$$\frac{\partial U}{\partial l_m} = \frac{\beta_{c\, l_m} + 2\,\beta_{l_m\, s}\, ln\, l_m + \beta_{c\, l_m}\, ln\, c}{l_m}$$

Since consumption and leisure can never be zero per definition there is no risk of taking the logarithm of 0. If we would take labour instead this could cause a problem.
In case of the translog specification D is the cross-term of characteristics with the logarithm of either consumption or leisure. Which of these will be used since showing a significant effect, will be discussed now.

3.6 Specifics of the Collective Model

As already mentioned the main difference between the collective and the unitary model is that the collective model understands the household as a sum of individuals. As such both partners in a household have their utility function that they would like to maximize. In order to obtain the budget constraint for each utility maximization problem, the intra-household decision process that can be fully summarized by the sharing rule has to be considered. The sharing rule, that describes the power distribution between man and woman in a household, indicates how the household income will be split between the partners. This then defines how much each household member can consume. Using this maximum consumption in the budget constraint allows the household member to solve his/her own utility maximization problem.

How to obtain the shares between the partners is up to the researcher as there

is not one unified way to calculate it. Explanatory variables that seem suitable are income of partners, their income potential (i.e. hourly wage), non-labour income, education and age. Even the body mass index has been used to explain power shares [5]. The sharing rule can either be a simple ratio of an observable variable for man and woman but could also steam from an advanced regression model. We will use various calculation methods in chapter 5 that of course lead to different predictions of consumption shares.
Once the power shares are estimated for every household, the utility function of each partner can be maximized. As in the unitary model different utility specifications are possible. In accordance to the former discussion, the functional forms discussed are the translog and the quadratic function.

Quadratic Utility Function

$$U^* = \beta_{c_i} c_i + \beta_i l_i + \beta_{c_i s} c_i^2 + \beta_{is} l_i^2 + \beta_{c_i i} c_i \, l_i + \beta_{fm} l_f l_m + \beta_{D_i} D_i + \epsilon_i$$

with the variables as introduced as above for $i = f, m$.

Translog Utility Function

$$U^* = \beta_{ci} \, ln \, c_i + \beta_{l_i} \, ln \, l_i + \beta_{c_i s} \, (ln \, c_i) = + \beta_{l_i s} \, (ln \, l_i) = + \beta_{c_i l_i} \, ln \, c_i \, ln \, l_i + \beta_{D_i} \, D_i + \epsilon_i$$

again for $i = f, m$.

Either of the utility specifications can be used to estimate the utility level that each of the working hours choice provide.
If one is for example only interested in the female labour supply behaviour this result might be sufficient.
As the objective of this paper is to explain the household labour supply choice, we should find a probability distribution over all possible combinations of men and women's working hours choices in order to compare it with the unitary model predictions. This can be done by generating a household utility, which is created by combining the likelihoods that the partners go for a certain choice that leads to a probability distribution that certainly sums up to 1.

In chapter 5 we will see how these steps can be translated empirically. Before that we should become familiar with the data that will be used to do so.

4 Data

4.1 Data Set

In order to allow for a comparison between the two approaches beyond the theoretical level, the EU-SILC data for Austria from Statistik Austria (drawn from 2004 to 2006) are examined.
Austria together with five other countries launched the EU-SILC project in 2003 and nowadays the EU-SILC survey is conducted by all member states of the European Union. It therefore provides a well-comparable overview of income-levels, poverty and other living conditions across countries.[15] Moreover, since many households are interviewed for four years, changes on individual and household level can be observed as well.
This international survey program has been established in order to compare social cohesion between countries. It should allow the European Union to do research on social inclusion, health issues, gender wage gaps and pensions that in turn should inspire new policies. The survey contains a rich amount of economic and sociographic variables that are yearly collected for several thousands of households and individuals. The main focus of the survey lies on gathering information about housing, labour, health, demography and education. The questionnaire collects information on a yearly basis. Additionally every year one target research topic (module) is issued that calls for extra specific data.
Income and other work-related variables are collected only for subjects aged 16 and older. Information about children is gathered using a special questionnaire. All variables are presented in both cross-sectional and longitudinal components. EU-SILC provides data about people with all kinds of marital status. This paper will however focus on couples. Single data will only be used to gather information about behaviour of singles in order to identify parameters in the estimation for couples. In total the questionnaire contains information about 4610 couples.
The data set includes a much-elaborated assortment of variables on the income side. The information on individuals' expenditures and even at the household level are comparably limited. The survey includes information about benefits, different sources of income and specific expenses, however none about general consumption. The latter is neither given on an individual nor on a household base. In particular for the analysis of the collective model this lack of detailed consumption data will lead to inaccuracies as discussed later. However, since in 2010 the target research question will be *Intra-household sharing of resources*, it can be assumed that in this year's survey more detailed questions about individual consumption behaviour will be included.

[15]For more detailed information see http://epp.eurostat.ec.europa.eu

4.2 Description of Relevant Variables

Consumption proxy:

Consumption usually plays a decisive role in utility estimation. In the unitary model one can use income as an alternative to consumption. This can however not be done within a collective setting since the sharing rule, one desired result of the estimation procedure, indicates how the income will be split within the household. Using income as a replacement for consumption, one would explain an income-related variable by income, which will lead to interdependencies and distorted results. Since no consumption information is available in the EU-SILC data set, a variable that captures the same (or at least a similar) behaviour should be used. An adequate variable to take the place of consumption proved to be monthly housing expenses. This variable captures rent, running costs, credit repayments, heating costs, maintenance and energy expenses. This seems to be a good approximation for consumption behaviour of a household since it varies with the economic climate in a country. Moreover it does not seem to be perfectly correlated with income, since the housing expenditures vary strongly with the household type and lifestyle. When the distribution of monthly income is compared to the housing expenses the difference is obvious. The consumption proxy is nearly normally distributed while the monthly incomes have two peaks. This could be due to part-time and full-time workers incomes (or more general low-paid jobs versus high-paid jobs) that create two mass points in the distribution, while housing is not offered in two price classes (or two sizes). General consumption can be expected to behave similarly to housing expenses as some is necessary (and prices are the same for everybody) and will not be proportional to the income but will be distributed around an average. A clear downside of that variable choice is that the housing costs are quite inflexible compared to the overall consumption. Just because income increases (or decreases) a bit, one will not switch to a more exclusive (or less expensive) flat. Therefore treating these expenses as a proxy is not ideal but is the most suitable approximation available in the data set.

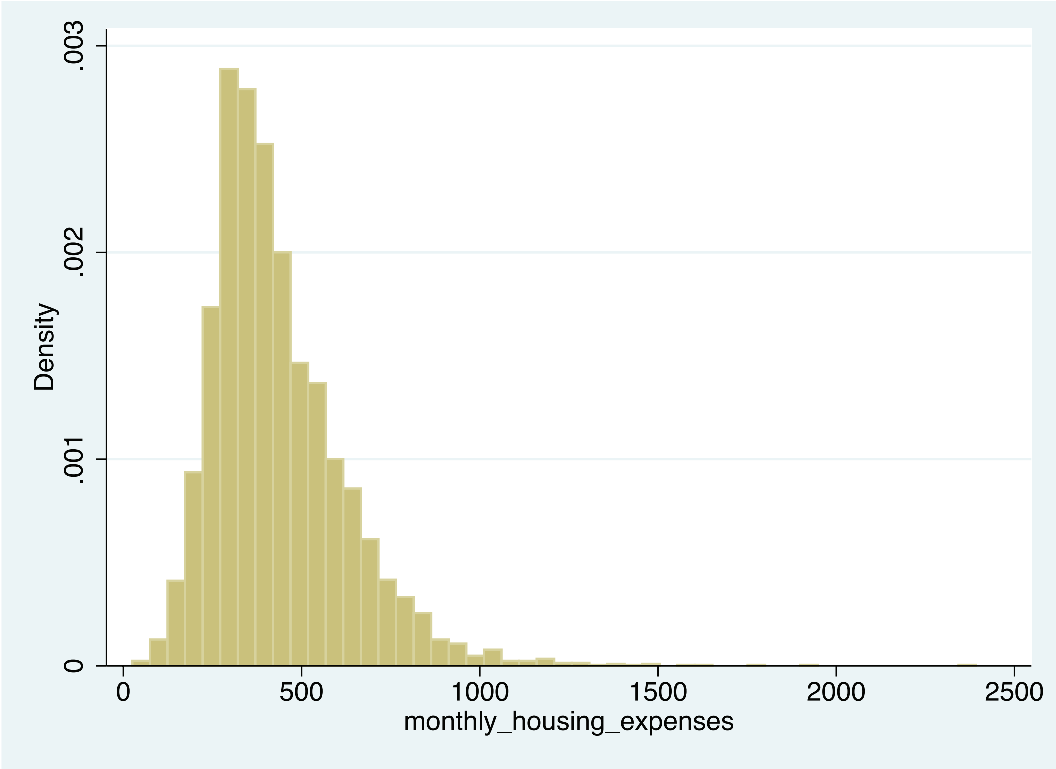

Figure 2: Monthly housing expenses for people in relationships

Income, Working Hours and Hourly Wage:

Incomes are self reported by the individuals and since that information is rather delicate there might be some misrepresentation. The working income is only stated per year so that the hourly wage had to be calculated dividing the yearly income by the denoted working hours. If the stated numbers were really unrealistic they were excluded from the data set or set equal to 0 when the wage was below a certain limit. When no wage was available for one year, and the household had taken part in the survey already before, the wage was assumed to be the same but inflation-adjusted. For unemployed people, or when there was just no information at all about the income available, the hourly fictitious wages have been obtained via Heckmann estimation. Since only wages of working individuals can be obtained and none of the unemployed a selection bias exists. Assuming for example that some people do not participate in the labour market because their reservation wage is above the market wage, we are missing information concerning their valuation of leisure. The Heckman procedure allows to circumvent the bias by predicting the missing wages making use of person-specific characteristics.[16] The estimation was done separately for men and women. The inverse Mill's ratio (selection coefficient) was significant and positive for females, which implies that there indeed seems to be a selection on the labour market for women.

[16]Person-specific variables are for example education, working experience, squared working experience, marital status, nationality, province.

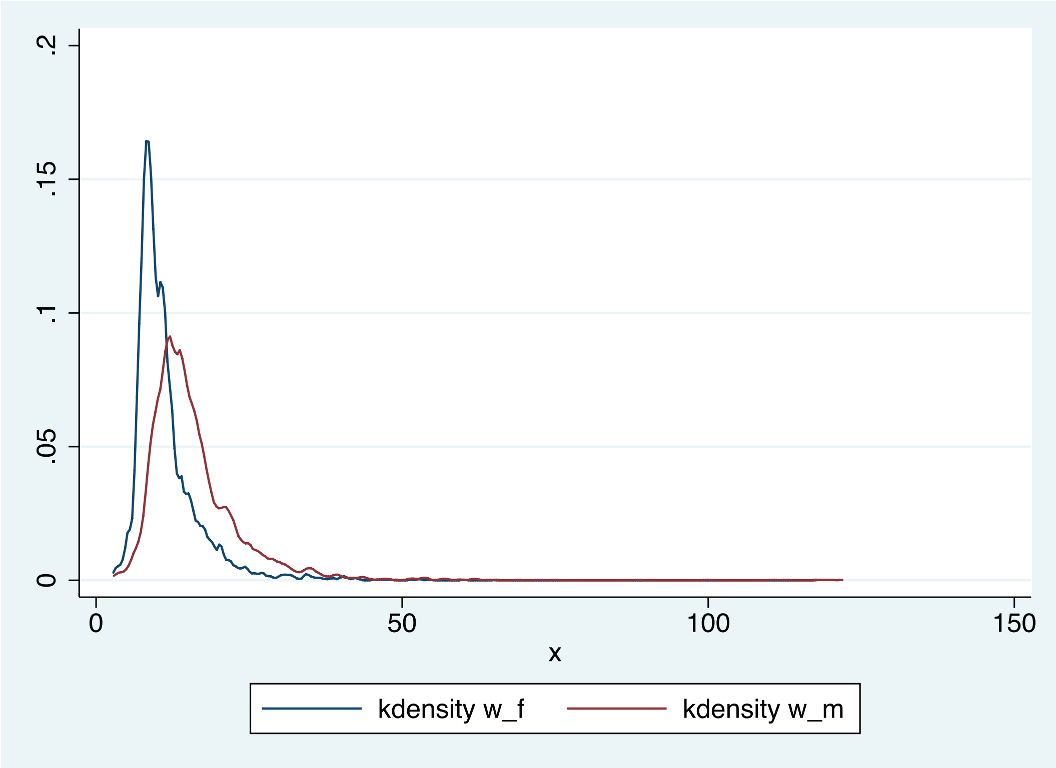

Figure 3: Wage distribution

There is a clear difference in average wage levels between men and women. The lower average wage of women can however be due to lower education. In order to check for that wages have been compared within education levels. The smallest gender wage gap was found between highly educated subjects (men 19.14 Euros per hour and woman 20.80 Euros). For intermediate and low education levels the gap is much larger. Low educated men earn on average 3.8 Euros more than their female colleagues, and intermediate education allows men to earn 3.7 Euros more. This shows that equal work[17] does not give women the same wage.
Wages will not be explicitly used in the estimation. They are however important since they define not only the income but also the consumption.

Another obvious gender difference can be observed in the working hours. The comparison between singles and couples reveals that women show a significantly different behaviour when they are in relationships while male working hours seem not to depend on the marital status.

[17]This can be concluded assuming that equal education implies equal productivity.

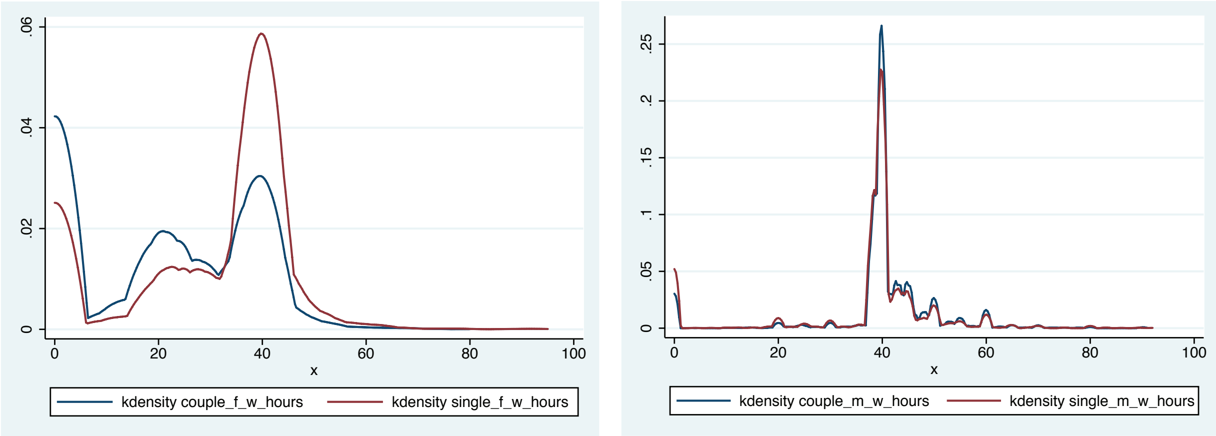

Figure 4: Working hours distribution for men and women depending on marital status

This observed pattern might already suggest that women have a higher elasticity concerning working hours when having a family.
The data set also shows that women work part-time much more often than men do as can be seen in the graph that already puts the working hours in four categories (0, 20, 40, 60 hours).

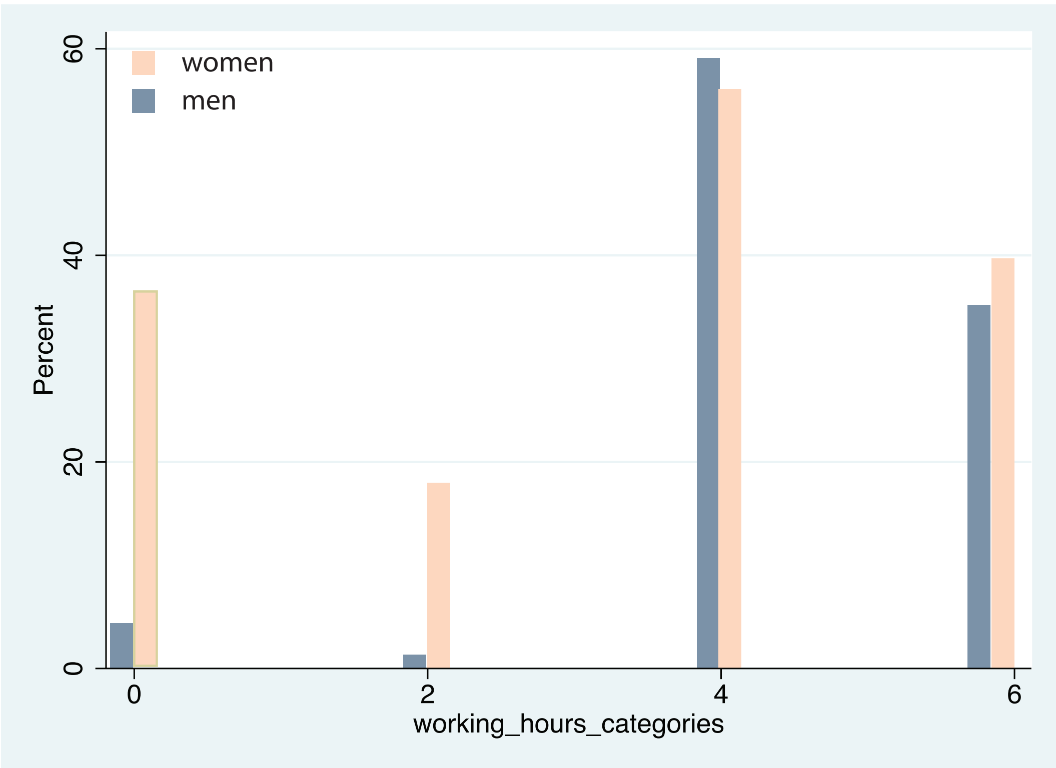

Figure 5: Working hours distribution for men and women in four categories

To see how education and the number of children affect the working hours, the average hours for men and women in different categories are displayed in the following table

Working hours		
	l_f	l_m
low education	21.6	39
middle education	27.3	40.1
high education	28.1	40.8
no child	28.2	38.3
one child	21.9	40.2
children ≥ 2	14.6	41

We see that education seems to influence the working hours choice of women while again it can be seen that men consistently choose to work full-time. The same behaviour is observed when the family size increases. With more children the mother works less, while once again the father's working hours alter only slightly.

Further Explanatory variables:

In order to explain working hours choice, personal characteristics are relevant. One very important variable is the number of children living in the household and their age. Because of that three variables have been created which indicate how many children aged from 0 to 2, 3 to 5 and 6 to 10 live in the household. The relevance of these variables is obvious since young children require a lot of care that can be supplied by the parents (or one of them) or by an institution (depending on the age group either nursery school, kindergarten, elementary school and after-school care club). This implies children either influence the working hours negatively or they incur certain care-related costs.

Further used explanatory variables are age and education. To predict the sharing rule, differences in these variables will be used to explain the within-household distribution. Thereby the difference in education is built following a paper by Crespo [13] in which he uses Spanish data.

4.3 Modelling of Austrian Transfer-Benefit System

Many studies based on collective and unitary models use a very simplified taxation scheme. In order to be able to interpret the results of policies, it is necessary to consider and include all the taxes and benefits for every possible income and household situation.

This whole system then defines the budget constraint for the individuals and households, thus the accurate modelling of the tax and benefit system is crucial in order to draw conclusions from estimation results. When studying policies, the changes of interest are implemented in the system and thereby it matches the available budget with every person and every labour choice. The overall change in labour supply then tells the researcher if the policy might have the expected result.

The research team around Dr.Zulehner has constructed this tax and benefit transfer calculator for Austria. In the first step they calculated the social security taxes depending on the occupational category and subtracted them from the stated gross incomes. Thereafter the tax base has been calculated according to the various personal and labour-related characteristics and the total tax burden deducted. The transfers are more complicated to capture, as some relevant information is not available. This happens for example for the unemployment payments, as no detailed information about previous employment is included in the EU-SILC data. Other transfers, as family and children allowances are straightforward to include. The social welfare benefits vary according to the province, which has been considered as well. Moreover the child-care benefits have been modelled in the transfer calculator which depends significantly on the province and if it is supplied privately or publicly.

The simulated income provides the model with the budget constraint but also gives information about consumption behaviour. The resulting simulated consumption was calculated multiplying the simulated income with the share of observed consumption of total income for every household. This means that if household i consumes $x\%$ of the total household income then it is assumed that if the household income rises the adjusted consumption is $x\%$ of the new total income.

Even though not all details of the system could be implemented the most important features of the Austrian tax-benefit scheme are captured.

5 Estimation Results

5.1 Unitary Model Results

The labour supply estimation based on 4610 households led to the following results.

Translog specification			
Variable	Coefficient	Std. Error	$P > \|z\|$
$\ln \mathrm{c}$	19.55	1.68	0.0
$\ln \mathrm{l}_m$	57.32	1.39	0.0
$\ln \mathrm{l}_f$	25.76	1.26	0.0
$(\ln \mathrm{c})^2$	-1.23	0.087	0.0
$(\ln \mathrm{l}_m)^2$	-7.47	0.17	0.0
$(\ln \mathrm{l}_f)^2$	-3.24	0.154	0.0
$\ln \mathrm{c}\ \ln \mathrm{l}_m$	-0.87	0.104	0.0
$\ln \mathrm{c} \ln \mathrm{l}_f$	-0.804	0.112	0.0
$\mathrm{age}_m\, ln\, l_m$	0.016	0.007	0.0
$\mathrm{age}_f\, ln\, l_f$	0.09	0.007	0.0
k(0-2) $\ln\ \mathrm{l}_f$	4.18	0.22	0.0
k(3-5) $\ln \mathrm{l}_f$	1.97	0.169	0.0
k(6-10) $\ln \mathrm{l}_f$	1.19	0.128	0.0

All the above coefficients are significant at a 5% level and allow us to draw the following conclusions.

First of all we see that the consumption and the leisure time of each partner are positively associated with the utility of the household. This result confirms our expectation. We also see that the husbands' leisure seems to have a stronger positive effect on the household utility than the women's. Intuitively one might explain this by considering an average household in which the woman works much less than her partner and therefore he might have a higher marginal utility of working (smaller marginal utility of leisure).

The quadratic terms for leisure and consumption have a significant negative effect of utility, which combined with the observed linear positive effects means that the utility is increasing in leisure and consumption up to a certain point, after which it decreases with additional units. This result is as well what we expected to find.

The cross-terms of leisure times and consumption are significantly negative which implies that the former moderates the effect the latter has on utility. An increase in leisure carries fewer benefits if consumption is high. If consumption is low the effect that leisure has on utility is higher. This result is a bit counter-intuitive, as we would expect that with a high consumption one profits more from an additional

unit of leisure. With less consumption one would assume there would be less need of additional income, hence a smaller utility of working an additional hour.
With age the utility from leisure increases for both sexes. For women only, an increased utility of leisure can also be observed if there are young kids in the household.

Quadratic specification			
Variable	Coefficient	Std. Error	$P > \|z\|$
c	0.005	0.001	0.0
l_m	0.282	0.0097	0.0
l_f	0.048	0.007	0.0
c^2	-7.6e-06	0.000	0.0
$(l_m)^2$	-0.004	0.000	0.0
$(l_f)^2$	-0.001	0.000	0.0
$c\,l_m$	7.6e-06	0.000	0.0
$c\,l_f$	7.4e-06	0.000	0.0
$age_m\, l_m$	0.0005	0.000	0.0
$age_f\, l_f$	0.0017	0.000	0.0
k(0-2) l_f	0.069	0.003	0.0
k(3-5) l_f	0.033	0.002	0.0
k(6-10) l_f	0.021	0.002	0.0

If we compare the results of the translog estimation with the quadratic one we encounter many similarities. Again consumption and leisure are found to have a positive influence on the utility of the household. The squared consumption, as well as the squared leisure terms are slightly but significantly negative, which again indicates that at a certain threshold of these variables further units have a decreasing marginal utility.
The interaction term between consumption and leisure is found to be small but positive, which, in contrast to the predictions of the translog model, supports our intuitive understanding that leisure will be appreciated more if consumption is high. Again the cross terms of women's leisure and young kids and leisure and the age show significantly positive results. This means that also for the quadratic utility specification an increased appreciation of women for leisure is found when there are many young kids in the household. Moreover leisure time seems to be valued higher with age.

Several different sets of explanatory variables have been estimated and the fit of those has been compared using goodness of fit measures. Here are the most relevant results.

Goodness of fit criteria		
	Translog	Quadratic
Log likelihood (intercept only)	-11464.65	-12773.316
Log likelihood (full model)	-6825.02	-8743.1
Likelihood ratio- χ^2(df)	9279.185 (13)	8060.1 (13)
Prob> LR	0	0
McFaden's adjusted R^2	0.404	0.314
AIC (intercept only)	3.307	3.801
BIC (intercept only)	-20674.771	-21265.38
AIC (full model)	13676.1223	17512.536
BIC (full model)	-9170.9	-7950.437

The first statistic in the table describes the log likelihood of the model with all parameters but the intercept set to zero. After including the stated explanatory variables the log likelihood increases in both models significantly (see second line). We see that the fit became much better however this statistic does not allow us to compare between the specifications but only within them (compare the fits of translog models among themselves and quadratic models among themselves).
The same holds for the likelihood ratio (LR), which is just the difference between twice the log likelihood of the full model minus twice the log likelihood of the restricted model. The LR statistic, tests the null hypothesis that all coefficients except the intercept equal zero, which is rejected for both specifications. The statistic is χ^2distributed with 13 degrees of freedom and once again can only serve as a comparison between nested models.
The regular R^2 is not interpretable as it is only a valid measure in the OLS estimation. McFadden came up with a similar measure that is applicable for discrete choice models as well, the McFaddens adjusted R^2. It is basically a likelihood ratio index of the form

$$R^2_{McF} = 1 - \frac{ln\,\hat{L}(\text{full model}) - k}{ln\,\hat{L}(\text{intercept only})}$$

with k as the number of parameters. The translog seems to have with 0.404 a higher degree of explanation than the quadratic one with a pseudo R^2 of 0.314.
In order to have an immediate feeling of the fit without running any tests, a counter was implemented that to measure how often the labour hours choice predicted to give the highest utility, actually coincided with the chosen working hours of the households. This means that both man's and woman's working categories have been

estimated correctly. This simple counter shows that 3.11% are predicted correctly by the translog model while only 2.25% of the working choices could be explained using the quadratic utility specification. These percentages appear to be small. It should however be noted that the arrangement of the four labour choice categories (0,20,40,60) have a huge influence here. Should their ranges be altered the fit of the models might change significantly. Moreover both partners' choices have to be predicted correctly in order to count the prediction as correct.
The comparison between specifications shows, as we already saw for the McFaddens R^2, that the translog model can obtain a better fit.
In addition to the pseudo R^2, the information measures AIC and BIC allow for comparison between non-nested models. The smaller the akaike information criteria, the better the model fit. For the bayesian information criteria the opposite holds. A more negative statistic is considered to point to the better fitting model. According to both of these statistics the translog is once again the superior one.
To sum up the results in one line, the translog specification seems to explain the data much better than the quadratic utility function does.
The following graphs allow a comparison between the predictions of both models and the observed choices.

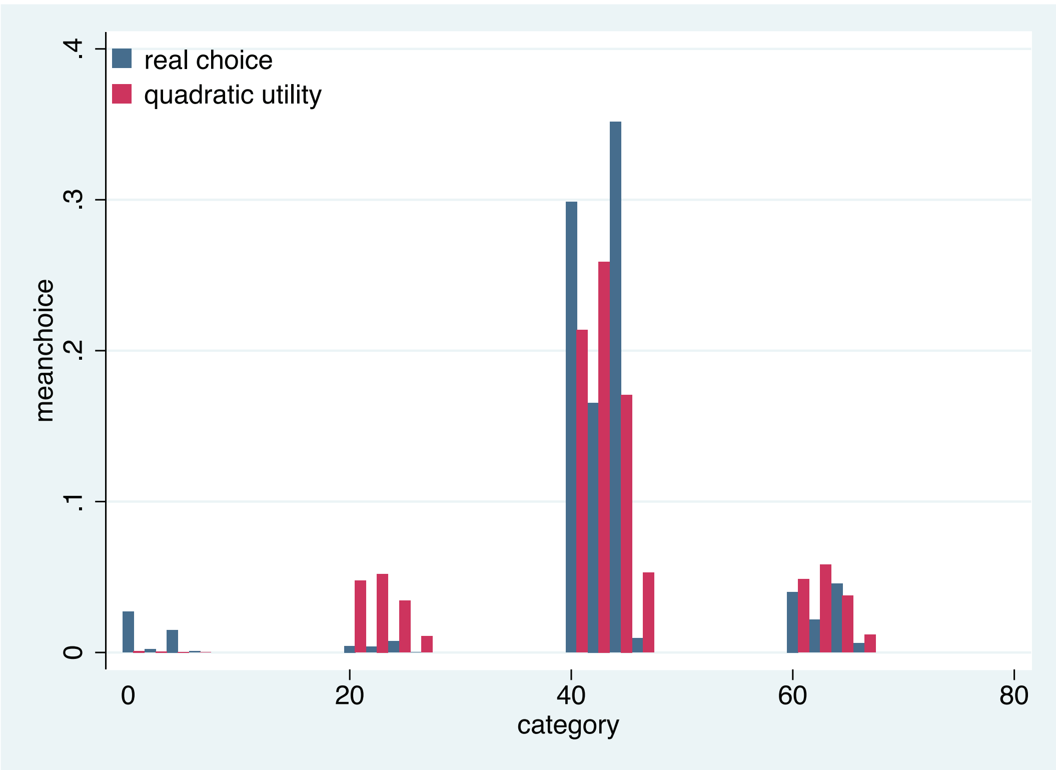

Figure 6: Estimated working hours choices of quadratic utility model

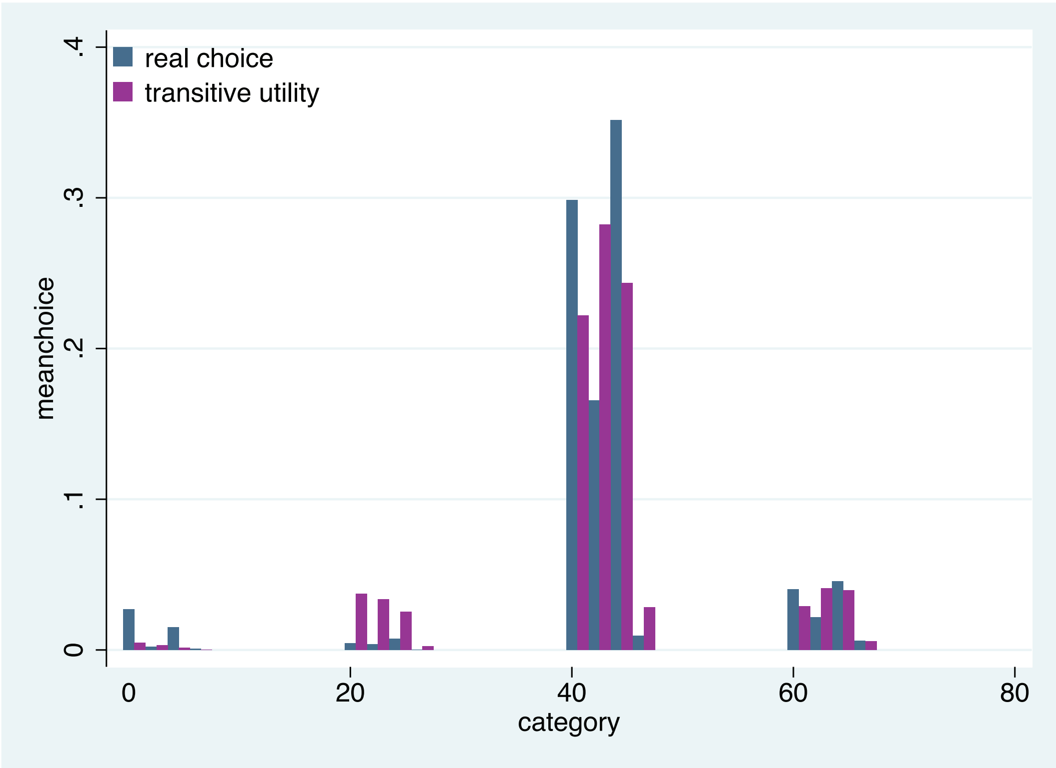

Figure 7: Estimated working hours choices of translog utility model

The assumption we made earlier that children do not have own preferences is quite unrealistic. It might very well be possible that the household type (no children, one child or many) does matter and the utility function (of either the household or the parents' ones) should be altered accordingly. In order to see if an adjustment according to the household type could possibly improve the fit we compare the degree of explanation for each number of children in the household. It turns out that in the translog model the fit is the highest for families with more than 2 children.[18] The same is observed for the quadratic model.[19] It seems that the both utility specifications are more suitable for larger families. This brings up an issue that could be interesting to investigate in further research.

To be able to judge the results properly we should rethink our initial assumptions. One of the most discussed ones is the income pooling assumption, which has already been touched in the theoretical discussion of the model. It says that the origin of income does not influence the choices of the households. This implies that consumption increases by the same amount when the household income grows due to a change in the woman's or the man's income. This again means that the marginal

[18]The fit of the translog model for childless couples is 3.12%, for household with one kid it increases to 3.17%, with 2 to 3.18% and finally for couples with many kids the fit is 3.58%.

[19]For childless couples the fit is 2.13%, for families with one kid it increases to 2.22%, with two kids to 2.43% and with more kids up to 3%.

propensity to consume must be the same for the man and the woman in the household, thus equal to the household propensity to consume. In order to check for that, regressions of consumption on household income are run for women in couples, men in couples and households. The parameter estimates are tested for equality using a t-test. The null hypothesis that they are insignificantly different must be rejected at a 5% significance level. This is an indication that the propensity to consume for men and women differs, and also the propensity of the household does not equal any of the individual's. As each equality hypothesis must be rejected, we have to reject the income pooling one.
This tells us that the members of the household do not behave as one single decision-maker, thus the unitary model and its results should be considered critically for the EU-SILC data.

5.2 Collective Model Results

5.2.1 Constructive Approach

Now that results for the unitary model have been obtained, the interest lies in finding out if the collective model can lead to an improved fit of the observed behaviour. In this section we follow the estimation method as used by Beninger [5].

To obtain the utility of the working hours choices, he first estimates a sharing rule that is based on several intra-household power indicators. He then uses this share for every household to construct the consumption of each partner. This information about consumption allows him to calculate the utility each household member has at this consumption level and the working hour choice of interest.
Beninger's approach will be explained in more details here and we will see the results of this approach for the EU-SILC data.

The sharing rule for the EU-SILC data will be obtained regressing the wage-ratio on other variables that explain intra-household bargaining powers. The wage-ratio defined as, $\frac{w_f}{w_f+w_f}$, is approximately normally distributed around 0.421.

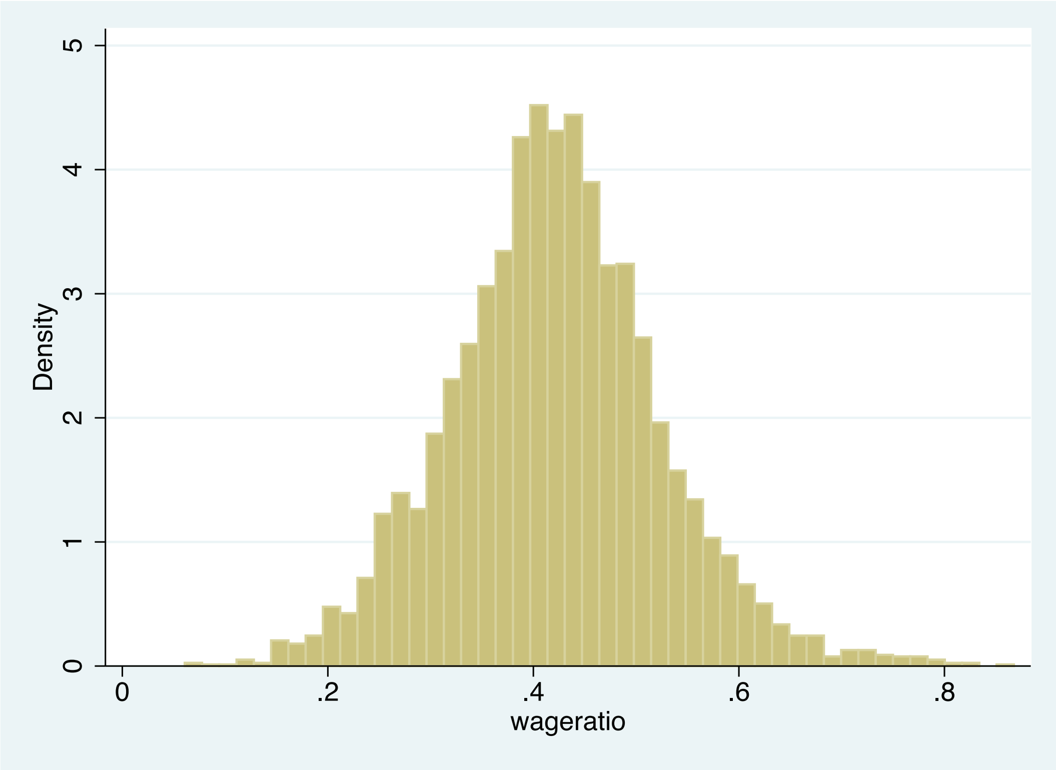

Figure 8: Wage ratio

One of the explanatory variables that will be used to explain the wage-ratio is the potential contribution of the female to the household wealth. With R_f defined as

$$R_f = \frac{y_f^{40}}{y_f^{40} - y_m^{40}}$$

the potential contribution reads as

$$y_f^{40} = \sum p_m^j (R_{mj}^{f40} - R_{mj}^{f0})$$

The term p_m denotes the sample frequencies of discrete weekly labour supply of the husbands. The obtained variable R_f fully captures the tax-benefit system.

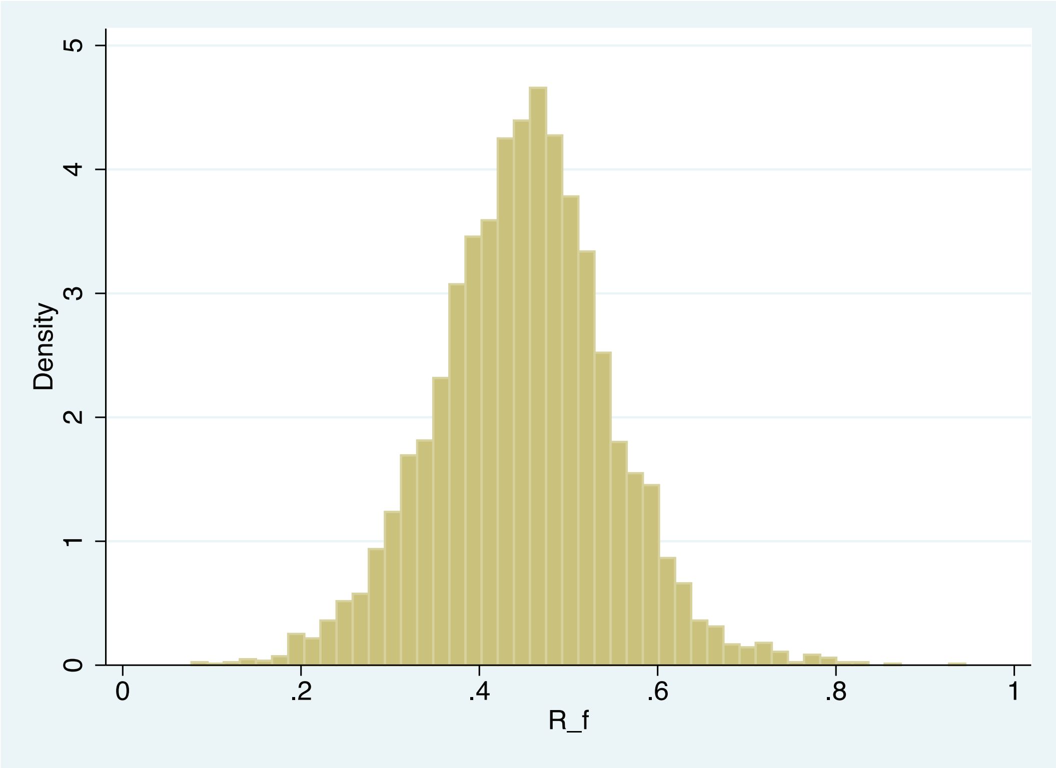

Figure 9: Potential contribution of women to household wealth

Instead of the wage-ratio Beninger uses another variable that should capture the power distribution within the household, which is the potential income strength of women defined as

$$IS_f = \frac{U^f_{eff} - U^f_{min}}{U^f_{max} - U^f_{min}}$$

where the maximum, minimum and efficient[20] utility levels are obtained from the predictions of the unitary model. This ratio should be bounded between 0 and 1 and can be understood as a measure of the potential income strength of the female part of a couple.[21] Unfortunately this ratio did not deliver any reasonable results for Austrian data. Since the wage-ratio seems to be a plausible measure for the income strength as well, this variable will be used instead.

In line with Beninger again, the sharing rule will be estimated as

$$\omega_m = \frac{1}{1 + \exp A}$$

with

[20]The efficient utility is the one that is reached at the realized choice of working hours as we assume that the individuals posses full information and are perfectly rational.

[21]The female power index is calculated solely for women with a partner.

$$
\begin{aligned}
A &= \alpha_0 + \alpha_{wf}\, w_f + \alpha_{wm}\, w_m + \alpha_{ww}\, w_f\, w_m + \alpha_{ni}\, hhni \\
&+ \alpha_{wfni}\, w_f\, hhni + \alpha_{wmni}\, w_m\, hhni + \alpha_{Rf}\, R_f + \alpha_d\, D
\end{aligned}
$$

where $hhni$ denotes the net income of a household and w_f and w_m label the hourly wages of women and men respectively. D represents socio-demographic variables like age, education and number of children. The logistic form guarantees that the power estimates are bounded between 0 and 1.
These results are obtained by running an estimation of the wage-ratio (our temporarily assumed sharing rule) on the wages, the wage interaction, the net incomes, R_f, and several household characteristics. The estimation method used is GLM (generalized linear models) which after comparison explains the wage-ratio best using Newton-Raphson optimization.

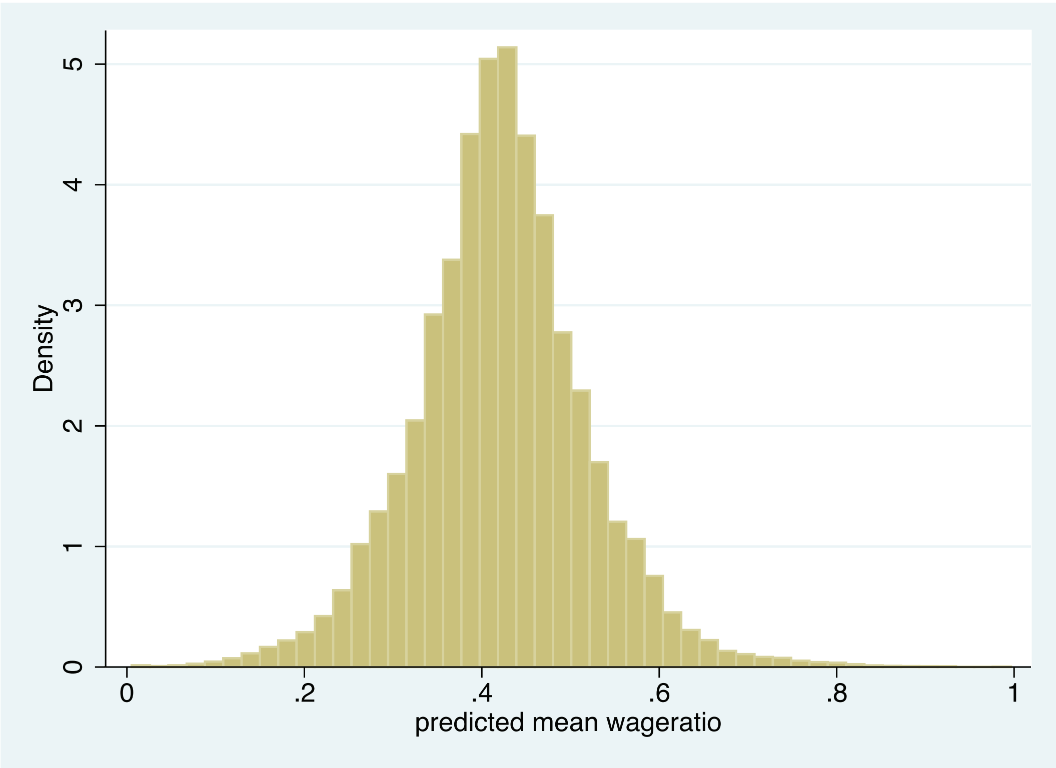

Figure 10: Predicted sharing rule

Using the obtained results the male consumption should be calculated by the following formula:

$$c_m = exp(\frac{\omega_m(U_m^{max} - U_m^{min}) + U_m^{min} - \beta_l^m ln(l_m) - \beta_{ll}^m ln(l_f) ln(l_m)}{\beta_c^m} + c_0 = V_m + c_0$$

Here U_m^{min} and U_m^{max} are obtained from a conditional logit estimation that is run for single men. The parameter ω_m is the predicted sharing rule (fitted values from wage regression) since it is the share of males. The remaining parameters, β_l^m, β_{ll}^m and β_c^m have been obtained from other model estimations. Precisely β_l^m is taken from the single men conditional logit estimation, and the interaction parameter β_{ll}^m came from a simple unitary household estimation.

We already notice that this method is quite artificial. We need to rely on many assumptions such as the parameters estimates for singles being equal to people living in a relationship. This assumption has often been rejected in studies and will therefore be analysed here too. In order to test this assumption for the Austrian EU-SILC data, the coefficients of consumption and leisure for men and women in relationships, as well as singles, have been compared. Then regressions of choice on leisure and regression of choice on consumption have been run by marital status. Women in relationships seem to evaluate leisure more than single women. For men the difference was insignificant at a 5% significance level.

Moreover no real comparison with the unitary approach is possible, as some elements are taken from this approach. If one is critical towards the unitary model, this collective modelling approach is not really attractive. Additionally the construction of the consumption term in the latest step is scale dependent on the utility. As utility is not a measure that can be compared for different models, this approach might lead to reasonable outcomes in Beninger's study, however there should be some doubt if this algorithm can be applied to any data set.

These flaws in the estimation procedure are also apparent for the EU-SILC data. The predicted consumption levels for men are all in a small interval around 0.

This clearly does not reflect reality at all. The lack of generalisation in the consumption formula might be due to the exponential expression. The interval of values that can be the argument of the exponential expression becomes quite small if we would like to obtain any reasonable consumption level as an outcome.

As no usable information for the consumption behaviour could be found, no utility estimation can be done. Beninger's approach did not lead to any result using the EU-SILC data for Austria.

5.2.2 Calibration Approach

The theoretical econometric approach that has just been discussed does not lead to reasonable solutions, therefore the attention now shifts to another approach that allows us to estimate the sharing rule, namely the calibration method.
Let the utility function be of the translog type

$$U_i^* = \beta_{c^i}\, ln\, c_i + \beta_{l^i}\, ln\, l_i + \beta_{ll^i}\, ln\, l_f\, ln\, l_m + \epsilon_i$$

for $i = f, m$. For single men and women the leisure interaction term is set to zero. By allowing people in a relationship to have this interaction term the separability of the partners in a partnership is weakened. This specification of utility assumes that the partners care about spending time together but not directly about the other's utility, which would also include the partner's consumption.
In order to obtain the labour supply decisions based on these utility specifications, one has to make two important assumptions. The first restriction is that we only consider convex hulls. Concretely we assume that all households include all lotteries over deterministic allocations (mixed strategies) to their domain of alternatives, and that the partners negotiate beforehand the final allocations for all the states of the economy and all the periods to come. This guarantees that the household chooses globally efficient allocations.
The second assumption is that people do not change their preferences when they are in a relationship. This allows us to use estimates of a conditional logit model for single men and women without kids[22] as proxies for preferences of people in a partnership. Concretely the single models yield estimates that describe the influence consumption and leisure have on the labour supply choice, and thus allow identification, as will be shown in the following section. That this assumption could not be supported by the data (as we discussed already in the last subsection) should be kept in mind.

Identification: In total six preference parameters and the power index have to be identified, β_f^c, β_f^l, β_m^c, β_m^l, β_{ll^i} and respectively μ. Under the adding up constraint, saying that the coefficient estimates of the utility model must sum up to one, we can normalize the utilities such that

$$\beta_i^c + \beta_i^l + \beta_{ll^i} = 1 \qquad i = f, m$$

[22] Single parents are left out because their preferences might include utility components that are related to their kid.

The assumption that people do not change their preferences when living in a couple implies that

$$\frac{\beta_i^c}{\beta_i^l} = \frac{\gamma_i^c}{\gamma_i^l} = \alpha_i \qquad i = f, m$$

The two restrictions above can be stated together as $\beta_i^c = \frac{1-\beta_{lli}}{1+1/\alpha_i}$ and $\beta_i^l = \frac{1-\beta_{lli}}{1+\alpha_i}$. The two household specific variables γ and μ are the ones that have to be calibrated using the information about the actual chosen labour supply.

The power distribution variable μ has to lie between 0 and 1 as it is defined at the percentage of power a partner has in a partnership. Contrary the leisure interaction term γ is not bounded below from 0 but can not exceed 1. For example, negative values seem reasonable for young parents that might prefer not spending their leisure time together, as one has to baby-sit the kid while the other might prefer to work meanwhile. According to Bargain and Moreau [4] there is a minimum value the interaction term can take in order to still fulfil the concavity restrictions on the individual utility functions. As stated by Bargain and Moreau these are

$$\gamma_{min} = \frac{-1}{(1+\alpha_i)ln(l_j - l_{minj}) - 1} \qquad for \quad i, j = f, m$$

If the identification assumptions are satisfied, the numbers calculated from the ratio of the consumption and the leisure estimates can be used to calibrate power and leisure interaction.

Econometric Estimation: Concerning the econometric estimation the paper uses the mixed logit model, which in general has the advantage of accounting for unobserved heterogeneity due to individual characteristics. Moreover the authors introduce regimes (or mass points) at the most common working hours. As it turned out that the mixed logit model does not lead to a clear improvement of results compared to the conditional logit model, the latter was chosen in this paper. Another reason why the conditional logit model was preferred is that is takes very little time for its iterations compared to the mixed logit one. This matters as these estimations are carried out multiple times during the grid search.

Another argument against the authors' approach is that the mass point might reflect the observed labour behaviour, without having it explained by explanatory variables, but just imposed externally to improve the fit. On the one hand the observations justify the praxis. Additionally the labour supply contract situation that allows mainly the choice between full-time and part-time employment support the choice. On the other hand the mass points are not explained within the framework but are just a reproduction of the observed structures. One could instead aim to find variables that serve as explanatory tools to model labour supplies in a simple, straightforward way. The latter approach, which is also used to model Austrian data, while dispensing with copying observed structures, goes at the expense of goodness of fit.

Results: The grid search over the power value and the interaction term at the same time shows that the interaction term has very small effect on the goodness of fit. This insensitivity of the leisure interaction term would imply that the partners in a relationship do not really care if they spend a lot or little time together, but solely on their consumption and their own leisure. This discovery combined with the utility function for couples tells us that the only interaction term between the partners falls away. The partner-component of the utility function is insignificant, which means that partners behave just as two independent individuals or that the utility function should be altered to model their caring.

The unsuitability of the utility function is reflected in the resulting utility maximizing power index. This is always one or zero depending on who has the highest earning potential.

This lies in the form of the household utility function combined with the insignificant leisure interaction term, which makes the partners' utilities independent from each other. As the overall household utility is just the weighted sum over the individual utilities, $U_h = \mu\, U_f + (1-\mu)\, U_m$, the higher utility should be weighted with one in order to maximize the sum.

Circumventing the problem a term has been included in the household utility function that captures the altruism. As this could not be done in the individual utility functions, the altruism will be modelled when merging the individual utilities. The best way of including this term can be found by another grid search.

First the income ratio between women and men, $\frac{inc_f}{inc_m + inc_f}$, is regressed on various explanatory variables. In comparison to the above estimation, this at least allows us to obtain very realistic power estimates, which are not one or zero but well distributed around 51%. In a second step we use the obtained predicted powers to infer the most appropriate altruism term. The maximizing function type clearly is $U_h = \mu\, U_f + (1-\mu)\, U_m - \sqrt{|U_f - U_m|}$. In contrast to the initially suggested definition of the utility function by Bargain and Moreau, this form allows the partner to care about the other's utility level. This implies not only the leisure spent together but also the consumption level of the partner.

Aiming to represent the altruism in a relationship, this specification seems adequate to model the dislike of large material inequalities between partners.

The fit statistics (AIC, BIC, McFadden's R^2) cannot be compared to the unitary model, as the conditional logit estimations are made for each partner and not for the household. Moreover the individual fits can not explain the fit of the household utility $U_h = \mu U_f + (1-\mu) U_m - \sqrt{|U_f - U_m|}$ since the interaction term is not considered.
One number that can be compared, though, is the percentage of cases where the chosen working hours combination of a household equals the choice that the model estimates to be utility maximizing. For the utility function with the utility interaction term this degree of explanation is 5,05%. This means that in around 5% of the cases the actual choice is equal to the predicted one. If we compare this to the results from the unitary model[23] we see that the fit of the collective model is clearly better.
We can again plot the distribution of utility maximizing working hours choices for couples as predicted versus the observed choices. The graphical representation shows as well that the collective model as defined above mimics the behaviour better than the unitary models do.

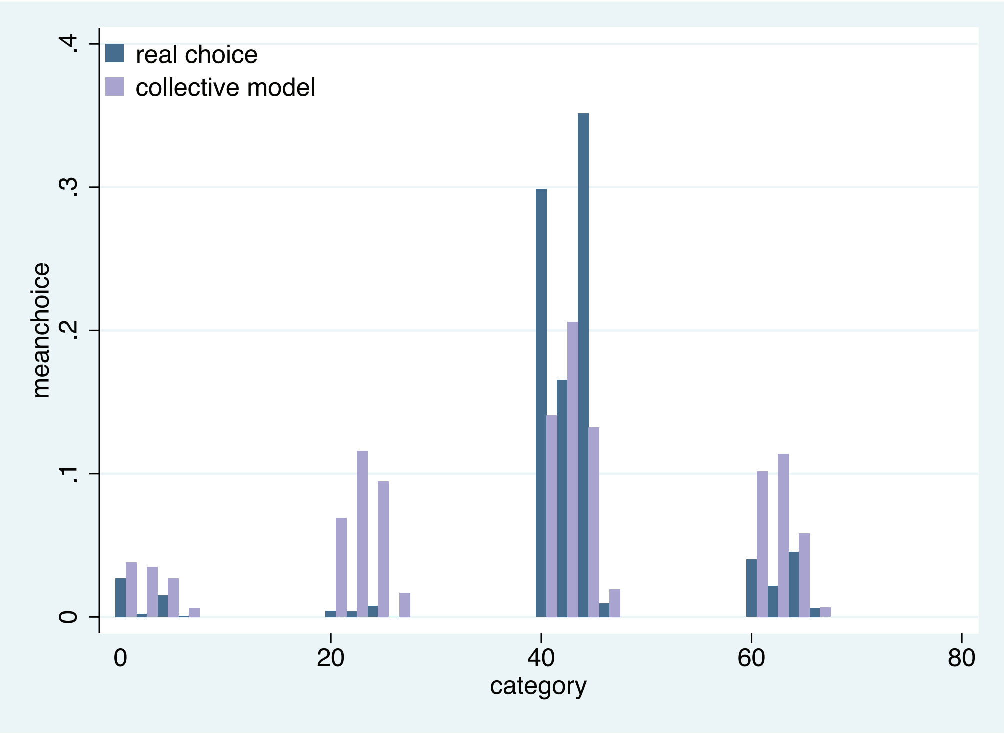

Figure 11: Estimated working hours choice versus observed one (with altruism)

[23]We had 3.11% in translog model and 2.25% in quadratic model.

As before these estimations can be carried out separately for each household type. Households without children have a degree of explanation of 6.25%, families with one kid 6.24%, and households with two kids show a fit of 5.91%. As in the unitary estimation the fit is the highest (with 6.15%) for households with more than two children.

In many papers the inelastic male labour supply has been addressed. It seems that men mostly work full time and their labour supply elasticity is very low when wages change. The strong preference for working full-time is also noticeable in the EU-SILC data set. This might have an immense negative effect on the fit. In order to check for that, men's working hours are set equal to their actual choice. Now, given their partner's labour choice, women's preferred working hours can be controlled for their fit. Compared to the estimation results for both sexes, the goodness of fit clearly increased to 13%. Conclusions drawn are that women's behaviour displayed in the data can be explained better by the utility function chosen.

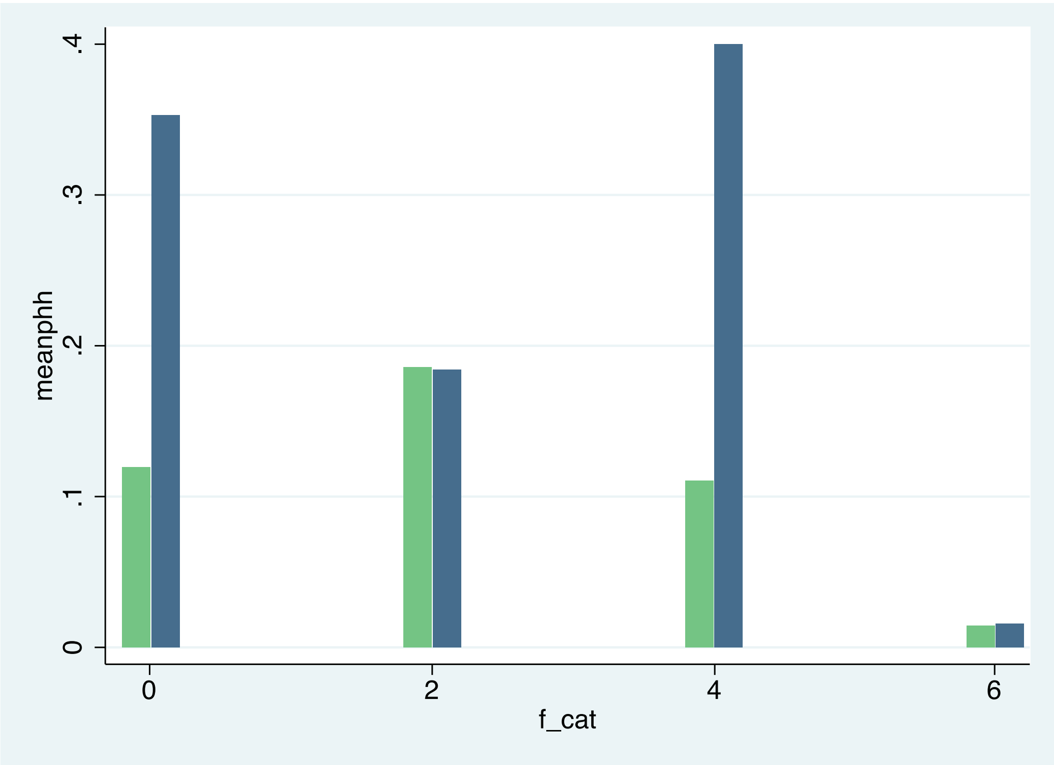

Figure 12: Estimated working hours choice vs observed one for women only

If all men are fixed at working full time (40 hrs) the fit decreases to 10.7% for women.

6 Final Remarks and Conclusions

Labour supply estimations are an important tool for economists to advice policy makers. The most often used model, the unitary one, considers the household as one decision-making unit. This has the obvious downside that individual changes cannot be estimated. A more technical weakness is the income pooling hypothesis that creates the testable core of the unitary model but has been rejected in many studies.

Theoretically the collective model that represents an alternative to the unitary model seems more plausible since it does not treat the household as a black box but allows for individual preferences. Implementing this model is however more difficult plus it requires individual specific data.

The static labour supply model is the theoretical base of both models. Depending on the chosen utility function, the indifference curves take their shape. The two most common utility functions are the translog and the quadratic ones. Including logarithmised respectively quadratic terms they define combined with the budget constraint the optimization problem.

The unitary model solves exactly this optimization problem for the household based on one of these two utility functions. The results from the empirical part show that the unitary model yields a fit of 3.11% using the translog model and 2.25% using the quadratic model. The fit statistics such as AIC and BIC confirm that the translog model describes the household's behaviour better. The result for the translog model suggests that women see a higher utility in staying at home if they have younger children. For both sexes we can find a higher evaluation of leisure with age.

The fit of the unitary model is not overwhelming which might be due to the found non-validity of the income-pooling hypothesis. The rejection of the hypothesis suggests that it very well matters who contributes which share to the household income and depending on the individual not cumulated income the working hours are chosen.

To see if the collective model allows us to estimate supply of labour better, two estimation methods that perceive the household as a pair of individuals are carried out. The first method that is based on Beninger's paper [5]. This calculation method, which uses several intermediate results of the estimation, did however lead to unrealistic results. The calculation procedure was stopped at the consumption levels since estimates for these were highly senseless.

The second collective estimation approach that is based on a calibration approach makes us doubt the construction of the household utility. The grid search over the leisure interaction leads to a result independent of this term. The variation of the power values shows unreasonable results as well. This is due to the structure of the

household utility. The results suggest rethinking the calculation of the collective utility. The power values are therefore obtained by a regression of the income ratio on several explanatory variables which estimate a power share of 51% for women. Considering that the household utility could not be explained in its recommended form, another grid search over possible formulas has been carried out. This suggests that the collective utility should not only be a weighted sum but additionally include an interaction term of the individual utilities of the form $\sqrt{|U_f - U_m|}$. This indicates that partners do care beyond their time spent together (if they even do). They seems to worry about the other's utility (which includes consumption as well). This means that the labour supply of a household depends on the individual's utility but also on the inequality between partners. Working hours choices that are based on this utility therefore depend on the consumption of the partner as well.
This approach leads to a fit of 5.05% which is a clear improvement compared to the utility model results.
Literature but also the EU-SILC data set shows an inelasticity of male labour supply. To control for that, men have been fixed at their actual choice. As expected this increases the fit significantly up to 13%.

We can conclude that the collective approach comes at the costs of problems in the implementation. First of all information on individual levels is required so that the collective approach can be carried out well. The estimates for the consumption levels based on the housing expenses are not ideal and we assume that the fit suffers from this imprecision. Presumably the EU-SILC data for 2010 will contain all these relevant information, since the topic this year will be intra-household distribution. Other possibilities to improve the degree of explanation would be to include the utility of children, only consider binary choices of men (work versus not work) or alter the discrete hours categories.

Considering all findings and difficulties one might advice the use of the unitary model in case that household behaviour is of interest- due to its simplicity. In case a policy is studied that is assumed to influence one partner more than the other, the collective model should be used despite its more complicated estimation procedure. The only way to tell one individual's change in behaviour is to perceive the person as such with her/his preferences. This might come at the cost of estimation hassle but when the right approach is found it can possibly explain the underlying behaviour much better.

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7 Appendix

7.1 Abstract

The purpose of this paper is to compare two approaches of estimating and modelling the labour supply of a household. Hereby the central question will be if a household can be seen as one decision making unit or if it should be perceived as two individuals (most often wife and husband) each with her/his own preferences. The unitary model captures the first perception while the collective model represents the two-individuals household concept. Later requires more individual data and a sharing rule needs to be calculated as one extra step. The two models will be explained and compared at a theoretical and an econometric level.
In order to see the models applied to real data the EU-SILC data set for Austria provided by Statistik Austria is used. Even though the data set is not perfect for the collective model, it allows us to see advantages and disadvantages that both models might have in empirical studies.
This paper uses a discrete hours approach that allows for four working hours categories and only considers multi-person households. The theoretical base for all models is the static labour supply model and the estimation technique used will be the conditional logit one. As these help to understand the estimation procedure, they will find some attention in this work. Furthermore the data will be described which allows us to immediately draw some interesting conclusions. Another central piece of this work is the transfer-benefit calculator that translates gross into net incomes.

The empirical results reject the income-pooling hypothesis that is the main assumption of the unitary model. It further suggests that women appreciate leisure more the more young children they have. Both partners enjoy leisure more with age.
The collective model estimation turns out to be quite cumbersome. It leads us to doubt the construction of the household utility and so a utility interaction term is included that punishes utility differences between partners.
Concluding it can be said that the collective model turns out to be less straightforward to estimate for the Austrian data. It however allows drawing conclusions on an individual level, which is a crucial property.

7.2 Deutsche Zusammenfassung

Die vorliegende Arbeit betrachtet verschiedene Arbeitsangebotsmodelle und evaluiert deren Schätzgüte im theoretischen aber auch angewandten Sinne (basierend auf den EU-SILC Daten 2004-2006 der Statistik Austria).
Die zwei Modelle die untersucht werden, sind unitäre Haushaltsmodelle, welche den Haushalt als einen einzelnen Entscheidungstreffer ansehen, und kollektive Modelle, welche die Individuen als solche erkennen und zu einem Haushalt kombinieren. Zuerst werden die theoretischen Grundlagen erläutert. Annahmen und Literaturüberblicke werden besprochen. Dem folgend wird das statische Arbeitsangebotsmodel, das beiden Modellen zu Grunde liegt, erklärt. Dabei handelt es sich um ein Nutzenmaximierungsproblem, welches auf Budgetrestriktionen und Nutzenfunktionen basiert. Weitere Modellannahmen und Eigenschaften der empirischen Schätzung werden erläutert, unter anderem die verwendete Conditional Logit Schätzmethode.
Vor dem empirischen Teil der Arbeit, werden die Daten begutachtet. Diese von der Statistik Austria stammenden Daten, wurden von einer europaweiten Datenerhebung namens *European Union Statistics on Income and Living Conditions* für die Jahre 2004-2006 bezogen. Die relevantesten Variablen werden erklärt und manche Statistiken liefern bereits aufschlussreiche Resultate. Unter anderem lässt sich erkennen, dass Männer unabhängig von der familiären Situation größtenteils Vollzeit arbeiten. Im Gegensatz dazu treffen Frauen mit verschiedenen Haushaltssituationen unterschiedliche Arbeitsangebotsentscheidungen.
Eine der wichtigsten erklärenden Variablen für die Arbeitsstundenwahl ist das Nettoeinkommen. Um dieses vom Bruttoeinkommen zu errechnen wurde von dem Team um Dr.Zulehner am WIFO ein Steuer- Transferrechner für Österreich entwickelt welcher es ermöglicht, vom Brutto auf das Nettoeinkommen zu schlissen.
Die Schätzung des Nutzens basiert auf zwei verschiedenen Funktionen, der translogen und der quadratischen Nutzenfunktion.
Das unitäre Modell schätzt diese auf der Basis von Haushaltsvariablen.
Das kollektive Model ist etwas aufwendiger zu schätzen. Man braucht eine Teilungsregel welche aussagt, welchen Teil des Gesamteinkommens die Frau und welchen der Mann bekommt. Diese Aufteilung wird geschätzt anhand von Variablen so wie Einkommenspotenzial oder Lohn. Nachdem die individuellen Nutzen geschätzt wurden, werden diese zu einem Haushaltsnutzen kombiniert. Dies geschieht durch eine Gewichtung (laut Teilungsregel) der einzelnen Nutzenniveaus.

Ein klarer Nachteil der unitären Modelle ist, dass individuelle Präferenzen keine Relevanz haben und daher können Reaktionen der einzelnen Haushaltsmitglieder nicht analysiert werden. Das kollektive Model erlaubt individuelle Präferenzen und ermöglicht damit Analysieren von Politikmaßnahmen, welche ein Haushaltsmitglied

mehr als ein anderes trifft.
Basierend auf dieser Grundlage würde man das kollektive Model bevorzugen. Jedoch erweist sich dieses in der empirischen Schätzung als problematischer. Zwei Methoden wurden angewandt. Die erste, welche Zwischenresultate verwendet, um eine Konsumschätzung zu erzielen, führt zu keinem Resultat. Der zweite Zugang, eine Kalibrierungsmethode, resultiert, wenn man dem Ansatz der Literatur folgt, im keinem interpretierbaren Ergebnis. Es erlaubt uns jedoch eine alternative Errechnung des kombinierten Haushaltsnutzens zu erzielen, indem man nicht bloß die Nutzenniveaus gewichtet und addiert, sondern einen Interaktionsterm einbaut, welcher den Unterschied der Nutzen der Partner adressiert. Dieser zusätzliche Term erlaubt es einen besseren Fit zu erzielen.
Das unitäre Model basiert auf der Annahme, dass die Herkunft des Einkommens unentscheidend ist und nur das summierte Haushaltseinkommen die Konsum- und Arbeitsangebotsentscheidung beeinflusst (Income Pooling Hypothese). Diese Hypothese findet jedoch keine empirische Bestätigung. Dieses Ergebnis lässt uns an den folgenden Resultaten zweifeln. Wir präsentieren sie jedoch, da sie vielleicht Grundtendenzen erkennen lassen. Das Ergebnis deutet darauf hin, dass der Nutzen wie erwartet (in beiden Modellen) mit Konsum und Freizeit positiv assoziiert werden kann. Frauen scheinen Freizeit mehr zu schätzen, wenn mehrere jüngere Kinder im Haushalt leben. Beide Partner haben eine höhere Präferenz für Freizeit mit steigendem Alter.
Vergleicht man die zwei Modelle für die EU-SILC Daten kann man festhalten, dass das unitäre Model einfacher zu schätzen ist. Daher ist es ratsam mit dieser Schätzung zu beginnen und auch deren Income Pooling Hypothese zu testen. Muss Letztere verworfen werden, deutet dies auf individuelle Präferenzen hin und man sollte ein kollektives Model schätzen. Diese zeichneten sich in dieser Arbeit durch ihre komplexe empirische Analyse aus. Falls man als ÖkonomIn jedoch an personenspezifischen Arbeitsangebotsveränderungen interessiert sein sollte, sind diese Hürden wert überwunden zu werden.

7.3 Lebenslauf

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Ausbildung

September 2009	ditact women's IT summer studies an der Universität Salzburg, 2-wöchiger Kurs über Java, Linux, Algorithmen und Hardware
2007-Jetzt	Master of Econometrics an der Universiteit van Amsterdam Spezialisierung Mathematical Economics Erwarteter Abschluss im März 2010
2003-Jetzt	Magister in VWL an der Universität Wien
2005-2007	Bachelor in Statistik an der Universität Wien Nicht abgeschlossen
Sommer 2005	ditact women's IT summer studies an der Universität Salzburg, SPSS Kurs
1995-2003	Matura (mit Auszeichnung) am Hammerling Gymnasium Linz

Berufliche Erfahrungen

Sommer 2009	Mathematiknachhilfe für GymnasiastInnen
Mai- August 2009	Scholarship am WIFO
Oktober - Jetzt	Buchhaltung Assistentin bei Sid Lee Amsterdam

Technische Fähigkeiten

Statistik Programme	EViews, STATA, SPSS
Anwendungen	TEX, LATEX, BibTEX, Microsoft Office und andere übliche Windows und Mac Anwendungspakete
Programmiersprachen	Processing