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**ALLOCATION WITHIN THE HOUSEHOLD:
DIRECT SURVEY EVIDENCE**

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Allocation within the household: direct survey evidence.*

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Abstract

We report on a new diary based expenditure survey that for the first time collects direct information on the allocation of *all* expenditures to different members of the household. The most important finding from the survey is that the mean share that wives have of all expenditures that are assignable to husband or wife is well determined and very close to one half. Despite this equality at the mean, there is considerable dispersion across the population and in half of households one partner receives twice as much (or more) as the other. Moreover, these expenditures comprise a sizable part of the household budget. For example, the mean joint expenditure by husbands and wives on their own private, assignable goods accounts for 11% of disposable income.

The main observable determinants of the variation in sharing expenditures across couples are a mixture of variables found in previous

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studies and variables that have not been considered before. As regards the former, we find that wives in higher educated and/or higher income households have a higher expenditure share. The other familiar effect is that the wife's share of assignable expenditures is increasing in her share of gross income. Turning to variables that have not previously been considered in the literature, we find that some of these are highly significant and also have a strong impact on sharing. If the husband had a mother who was in full-time employment when he was aged 14 then he receives over two percentage points more of assignable expenditure than if his mother was not employed full-time. The strongest effect is also the most puzzling. If the wife has a child who is not the natural child of her partner then she receives six percentage points of assignable expenditure less than an otherwise comparable woman. On the other hand, men do *better* if they have had a previous child.

1 Introduction.

Within economics and sociology, the household was for a long time conceived of as a unity with goals that are agreed by all members (the so-called ‘unitary’ model). In the last twenty years, however, economists have questioned that assumption and have elaborated models allowing for different preferences concerning the allocation of time and money within the family (see Lundberg and Pollak (2003) and Browning, Chiappori and Lechene (2006) for references and discussion). Simultaneously, economic psychologists and sociologists have studied the decision-making processes and power-relations within the family (see, for example, Vogler (1998) and England and Folbre (2006) for surveys). Although there is widespread agreement that the unitary assumption is inappropriate, there is no consensus on what should replace it. We believe that the lack of appropriate data is the most important impediment to progress in this area. Acting on this belief we have developed and conducted a new survey that is designed to throw more light on intra-household allocation.

Our data are drawn from the Danish Household Expenditure Surveys conducted in the years 1999 – 2003. This is a conventional diary based expenditure survey for which we have collected three novel sets of additional information. The most important innovation in our survey is that respondents who live with someone else¹ are asked to record for whom the goods purchased are bought; as far as we aware such information has never been collected before for all goods in a large and representative survey. A second innovation is that we collect information on decision processes for the surveyed households. The allocation information tends to be the focus of studies by economists whereas decision processes are often of more interest to sociologists (see, for example, Pahl (1995) and Heimdal and Houseknecht (2003)). We hope that having both types of information for the same households will facilitate a synthesis of economic and sociological research in this area. The third innovation in our survey is that we collect background information on the husband and wife that is not usually collected in expenditure surveys. For example, we ask about the labour force status of the mothers of the husband and wife when the respondents were 16 years old and also about previous marital and fertility outcomes.

¹Strictly, we only collect this information for married or cohabiting heterosexual couples who may have dependent children but no other adults in the household.

In this paper we present results on the sharing of expenditures on private goods between husband and wife. We define as *assignable* any expenditure that respondents say was bought either ‘for him’ or ‘for her’ (the other alternatives are ‘for the household’, ‘for children’ and ‘for someone else’). Given expenditures on assignable goods, we define the *sharing rule* (see Browning *et al* (1994)) to be the ratio of expenditure on the wife’s assignable goods to the total expenditure on assignable goods. Whatever the decision process the family adopts (unitary, collective, non-cooperative or some procedure that cannot be rationalised within a neoclassical framework) there is always a sharing rule since respondents always record some assignable expenditures. Sharing within the household is of interest in its own right and it also an intermediate step in finding out about within household decision making. For example, in a collective model the use of a sharing rule allows households to implicitly decentralise allocation decisions by giving each person their own money to spend on their own private goods. The emphasis in this paper is on the mean and distribution of the sharing rule across the population of couples and the observable determinants of sharing such as relative incomes, background variables and the level of income. One of the principal advantages of our data is that it allows us to identify the sharing rule for each household with no supplementary assumptions. As Bourguignon, Browning and Chiappori (2006) show, the location of the sharing rule (that is, the mean level for a baseline demographic stratum) is not identified from data on couples alone unless we observe the allocation of *all* assignable goods within the household.² Thus we present our results as reduced form estimates in the sense that any theory based model of household decision making is required to be consistent with the facts we present below.

Given that our data are collected explicitly to address a particular research question, the empirical analysis should be fairly routine. Unfortunately the analysis is much complicated by the fact that the expenditures are taken from a two week diary and hence suffer from significant infrequency of reporting for some goods. For example, only 32% of men report buying clothes within the sample period whereas all are, presumably, buying clothes in the long run. In the first empirical section we present some very basic results on the data with no correction for infrequency. In the following

²Browning, Chiappori and Lewbel (2003) show that under strong assumptions, if we also use information on single person households we can also identify the location of the sharing rule.

sections we develop a statistical framework that allows us to take account of infrequency. We find that although husband and wife spend quite different amounts on individual goods such as clothing, personal services, alcohol and tobacco, they have broadly equal total assignable spending. The mean value of the sharing rule is very close to one half. However, equal sharing is by no means the norm and we find that the sharing rule is quite dispersed across our sample; in about half of the sampled households one partner receives at least double that the other receives. The significant observable determinants of the sharing rule are a mixture of variables that have been found in past studies (for example, relative incomes) and other variables that have never been considered before. For example, we find that either partner having had children from before the current partnership has a major impact on the wife's share of assignable expenditures.

2 The theoretical sharing rule.

Each period, the members of a household have to make decisions concerning the allocation of household income net of committed expenditures (such as housing, insurance payments and mandated pension contributions) between saving, durables, public goods (such as heating) and private goods (for example, food, clothing and personal care goods). In this paper we concentrate on the allocation of expenditures on private nondurable goods for a two person household with members A ('her') and B ('him'). Taking as given the amount that the household decides to spend on private goods, we divide the total expenditure on private goods into three categories: items bought exclusively for A , items bought exclusively for B and items bought 'for the household'.³ The latter category for private goods has not been considered in the literature but, as we shall see, it seems to be a natural category for survey respondents. For example, in our survey food is reported to be a good that is largely bought 'for the household' even though it is strictly a private good in the sense that there is rival consumption. Private goods that are bought exclusively for one person or another are defined to be *assignable goods*, whereas private goods that are bought for the household are defined to be *non-assignable*.

There are many alternative models of how allocation decisions are made.

³In the survey work we have five categories but it suffices to consider only three to bring out the main points here.

The most commonly used in economics is the unitary assumption that posits that there is a household utility function over all allocations. Alternatively some decisions may be made cooperatively and others noncooperatively, with each household member using their own preferences to order proposed allocations. For the purposes of this paper the important point is that whatever mechanism is used to decide on allocations we can always define individual expenditures on assignable goods and hence a sharing rule. The existence of a sharing rule is *not* dependent on assuming a particular model. The empirical results presented below can thus be considered as a reduced form for *any* model of intra-household allocation. Formally, denote the total expenditure on A 's private assignable goods by x_A and similarly for x_B . We define the *sharing rule* as:

$$\rho = \frac{x_A}{x_A + x_B} \quad (1)$$

This paper focuses on the level and observable and unobservable determinants of the sharing rule. The variables that determine the sharing rule depend on the model used. For example, the household might simply set ρ to be a constant. Alternatively, the sharing rule might be variable and depend on what we shall call *sharing factors*; that is, factors that determine the allocation of total assignable expenditure. If we denote the vector of these by $\mathbf{z}$ then we have a function $\rho(\mathbf{z})$. Which variables enter $\mathbf{z}$ will depend on the model. For example, a marriage matching model would emphasise variables such as attractiveness, relative wages and the ratio of men to women in the local marriage 'market'.

In the recent literature the model that has received the most attention is the *collective model* (see Chiappori (1988) and Browning and Chiappori (1998)). To derive the sharing factors for this model, suppose that there are n private goods with prices $\{p_1, p_2, \dots, p_n\} = \mathbf{p}$. For convenience we assume that all goods are assignable. Let $\{q_1^A, q_2^A, \dots, q_n^A\}$ be the vector of goods bought for A and suppose that agents have egoistic preferences over their own private goods that are separable from all other goods.⁴ Let A 's preferences be represented by the utility function $\nu^A(q_1^A, q_2^A, \dots, q_n^A; \mathbf{z}_A)$ where $\mathbf{z}_A$ is a vector of *preference factors* (taste parameters) for person A (and similarly for B). Suppose now that however decisions are made, the outcome is efficient so that we have a collective model. In this case the household behaves

⁴In all that follows we could condition on the levels of public goods and leisure. This complicates the notation without adding anything that is surprising and/or interesting.

as though it has a household utility function:

$$\nu^A(q_1^A, q_2^A, \dots, q_n^A; \mathbf{z}_A) + \lambda(\mathbf{z}_D, \mathbf{p}, x) \nu^B(q_1^B, q_2^B, \dots, q_n^B; \mathbf{z}_B) \quad (2)$$

where the Pareto weight, λ , depends on so-called *distribution factors*, $\mathbf{z}_D$, and prices $\mathbf{p}$ and total expenditure, x (see Browning and Chiappori (1998)). By definition, preference factors do not enter the Pareto weight. Let $\hat{q}_i^A$ denote the optimal allocation of good i for person A according to this utility function. This will depend on $(\mathbf{z}_A, \mathbf{z}_B, \mathbf{z}_D, \mathbf{p}, x)$ so that we have:

$$\rho = \frac{\sum_{i=1}^n p_i \hat{q}_i^A(\mathbf{z}_A, \mathbf{z}_B, \mathbf{z}_D, \mathbf{p}, x)}{\sum_{i=1}^n (p_i (\hat{q}_i^A(\mathbf{z}_A, \mathbf{z}_B, \mathbf{z}_D, \mathbf{p}, x) + \hat{q}_i^B(\mathbf{z}_A, \mathbf{z}_B, \mathbf{z}_D, \mathbf{p}, x)))} \quad (3)$$

so that the sharing rule will in general depend on preference factors, distribution factors, prices and total expenditure.

Suppose we have a candidate set of factors that determine preferences and distribution within the household, a vector $\mathbf{w}$ (for example, $(\mathbf{z}_A, \mathbf{z}_B, \mathbf{z}_D, \mathbf{p}, x)$ of the previous paragraph). We can partition this set into those variables that are sharing factors (call these $\mathbf{w}_S$) and those that are not sharing factors (call these $\mathbf{w}_N$). The following gives the relationship between the two total expenditures.

Proposition 1 *A necessary and sufficient condition for the sharing rule, as defined by 1, to be a function of $\mathbf{w}_S$ and not of $\mathbf{w}_N$ is:*

$$\begin{aligned} x_A &= \phi^A(\mathbf{w}_S) \psi(\mathbf{w}_N) \\ x_B &= \phi^B(\mathbf{w}_S) \psi(\mathbf{w}_N) \end{aligned} \quad (4)$$

The important features of the structural relationship in 4 are the multiplicative form and the fact that the function of the variables that are not sharing factors is the same for both partners. Given that each total is the sum of expenditures on individual goods, this implies that the individual expenditures have a similar structure with the same multiplicative function $\psi(\mathbf{w}_N)$ for each partner and good.

In the literature the distinction between sharing factors (those variables that enter the sharing rule, whatever the model) and distribution factors (the variables that enter the Pareto weight in collective models) is not always clearly maintained (see Browning, Chiappori and Lechene (2006) for

a discussion). One useful result that follows from the proposition above is that if we have a collective model, all distribution factors are sharing factors (elements of $\mathbf{w}_S$) but not all sharing factors are distribution factors (that is, some elements of $\mathbf{w}_S$ may not enter the Pareto weight). This implies that if we have a candidate sharing factor that can only be a distribution factor (for example, the sex ratio in the age relevant population) and it does not enter the sharing rule ‘significantly’ then it does not enter the Pareto weight. Consequently we can rule out any structural collective model or bargaining model that implies that the variable should be a distribution factor.

3 The Danish intrahousehold survey.

3.1 Survey design.

Our data are collected in conjunction with the Danish Household Expenditure Survey (DHES). This is a continuous survey of approximately 1,000 households per year; it is a cross-sectional design with no panel element. The DHES is administered by the Danish official statistical bureau, Danmarks Statistik. The DHES includes a questionnaire and an accounting book (‘diary’), the latter being self-administered by each adult in the household. At the start of the two week survey period each adult member of the household is given an accounting book in which she/he is asked to record all expenditures during the survey period of two weeks. At this time some demographic information is collected and also retrospective information on expenditure on housing and on large, infrequently purchased items such as cars, white goods and furniture. At the end of the survey period the interviewer returns to the household and administers a questionnaire. This is a standard design for expenditure surveys. To this we add two sets of supplementary information for each respondent household that is headed by a married (or cohabiting) couple.

The first set of supplementary information is that in the diary, each respondent records for whom each item was bought. To our knowledge such information has never been collected before for a wide range of expenditure categories. To give this information, each respondent goes through their own diary with the interviewer and for each item records who the good was bought for. A code-description is displayed on a card to the respondent indicating the possible ‘for whom’ categories. The specific question for each

diary item is: "for whom was this good bought?" and the allowed responses were: 'mainly for her', 'mainly for him', 'for the household', 'mainly for the children in the household' or 'mainly for someone outside the household'. There is also an sixth option: 'cannot assign'. The survey design prefers that each respondent gives information about their own diary but sometimes only one member is willing to be interviewed in which case they respond to these questions for all diaries. In the event, in 76% of households both husband and wife responded and for the other households it was roughly the same proportion of husbands responding as wives. Although this part of the survey looks onerous it is, in fact, relatively quick and did not add significantly to the survey burden. Clearly the answers to these questions contain some ambiguity. For example, in a preliminary focus group meeting the question arose as to how to respond if the couple bought a bottle of wine and the wife drank one glass from it and the husband the rest. Is this expenditure 'for him' or 'for the household'? Interviewers were instructed *not* to give guidance on this but to simply ask the respondent to record how they see it.

The second set of supplementary information is a set of extra questions at the end of the final DHES interview. Basically there are three types of extra questions. First, there are questions on the background of the respondents. These include how long they have been living together; their past fertility and marital histories and their mothers' labour market status when they were 14. The latter have been useful in, for example, analyses of French budget surveys. Second, we have a small suite of questions concerning the management of household finances and how much autonomy husband and wife feel they have. These are modelled on questions asked in other surveys that have been conducted by sociologists and economic psychologists (see, for example, Vogler and Pahl (1994)). Finally we have some questions that we designed ourselves on the effect of a hypothetical transfer of income from one person to the other in the household. This is to address directly the 'income pooling' question and to test whether we can obtain direct evidence on intra-household allocations. In this paper we shall only be using information from the background questions.

A pilot study was conducted in September to November 1998, and the results collected were used in preparing the final questions for the DHES. Surveying began in early 1999. We only interviewed couples in which both were aged between 19 and 59. This gave an initial sample size of 1,645 couples

by the end of 2003.⁵ After removing households that did not report all of the information we need and selecting on both husband and wife having positive gross income, we have a sample size of 1,537.⁶ One notable feature of survey data in Denmark is that we can use personal numbers to link the survey information to a very wide range of administrative data for each respondent. The latter includes labour force status, marital status, earnings and asset income (for tax returns) and housing information. This expands the possible analyses that can be conducted with our data.

3.2 Response rates.

In the subsequent analysis we group private goods into seven standard non-durable or semidurable commodities: ‘food at home’, ‘vices’, ‘clothing’, ‘household services’, ‘transportation’, ‘recreation’, and ‘personal services’. The main items in ‘vices’ are alcohol beverages (whether consumed at home or outside), tobacco products and eating out. The latter is often treated as a commodity in its own right but here we have grouped it with alcohol and tobacco to reduce the number of commodities. Since it is of some interest, in the appendix we present some information on the distribution of expenditures on alcohol, tobacco and eating out. ‘Household services’ includes items such as telephone and postal costs and ‘transportation’ includes gas and insurance for a car as well as bus and train expenditures. Whilst some of these items can certainly be considered private (in the usual sense of rival consumption) others of them may be termed ‘household’; fortunately we do not have to make that imputation ourselves since respondents do it in the survey. ‘Recreation’ includes items such as books and newspapers and cinema tickets and ‘personal services’ includes hair dressing and personal hygiene. The major expenditure items that we do not analyse are ‘housing and utilities’, ‘durables’ (such as white goods and furniture) and ‘medical

⁵The number of households surveyed each year in the DES (1,000 for all types including non-couple households) is small by international standards (the usual sample size is usually in excess of 7,000 households per year). Given our focus on couples we have had to wait four years for a large enough sample size for analysis.

⁶The selection on having positive gross income effectively means that all husbands and wives had some market work during the survey year. This does not exclude many households since labour force participation for prime age men and women in Denmark is high by international standards. The analysis of households in which only one partner normally participates in the labour force must be left to future work.

Good	Zero expenditures	Proportion not distributed	Budget share
	(%)	(%)	(%)
Food at home	0	8.9	32.8
Vices	1.9	1.6	14.8
Clothing	13.5	1.1	12.3
Household services	1.6	2.6	4.9
Transportation	10.7	1.4	13.1
Recreation	1.6	1.7	15.0
Personal services	4.2	1.3	7.1
Total	0	4.1	100

Table 1: Summary statistics on commodities

and schooling’ expenditures⁷. The seven commodities we analyse account for 43% of net disposable income. Table 1 presents statistics on the proportion of zero expenditures by the household in the two week period, the proportion of expenditures *not* allocated to one of the five recipient groups, and the mean budget share for each of the commodities. sample. As can be seen from the first column, there are relatively few zero purchases within the two week survey period (column 1) but, as we shall see, when we start looking at purchases for individuals there are considerably more zeros. The second column indicates that respondents were quite willing to assign purchases to different people or to the household. The relatively high rate of non-response for ‘food at home’ is because we asked interviewers not to ask for the distribution of this category in the initial months of the survey. After some months interviewers reported that it was easier to ask the assignment question for all diary items (and some had been doing that all along) and the design was changed to require this. Finally we note that food at home has the largest mean budget share and household services has a small budget share.

⁷By international standards, medical and education expenses are low in Denmark since the state provides significant support for these items.

4 The assignment of recorded individual goods.

In this section we present results that ignore the infrequency in the data generation process. For goods that are bought infrequently, the mean of the observed purchases (which includes those who do not buy in the observation period and those who do buy) is equal to the mean long run expenditure (see, for example, Pudney (1989) or the proposition in subsection 5.3 below). Thus means of observed expenditures on individual goods and the sums of these are unbiased estimates of the ‘true’ long run means. On the other hand, the mean sharing rule (which is of primary interest) is not equal to the long run mean. To illustrate, suppose there is only one good and reporting of the expenditure on this good by each partner is subject to infrequency. Let x_A and x_B be the ‘long run’ mean expenditure for A and B respectively with the long run sharing rule value given by 1. Let the probability that we observe a positive purchase in the survey period be the same for both partners with value π and assume that purchasing behaviour is independent across the two partners. If a purchase is observed then the amount observed is $q_A = x_A/\pi$ for A and $q_B = x_B/\pi$ for B . The observed sharing rule, denoted ρ^o is the ratio of the observed expenditure by A divided by the observed total expenditure. We have the following outcomes:

$$\begin{aligned}\rho^o &= \frac{q_A}{q_A + q_B} = \frac{x_A}{x_A + x_B} = \rho \text{ with probability } \pi^2 \\ &= 0 \text{ with probability } \pi(1 - \pi) \\ &= 1 \text{ with probability } \pi(1 - \pi) \\ &\text{missing with probability } (1 - \pi)^2\end{aligned}\tag{5}$$

The mean of the observed sharing rule (with scaling to allow that we cannot compute the observed sharing rule if both values are zero) is:

$$E(\rho^o) = \frac{(\pi^2\rho + \pi(1 - \pi))}{1 - (1 - \pi)^2}\tag{6}$$

This is equal to the true value, ρ , if and only if $\pi = 1$ or $\rho = 0.5$. Thus the mean of the observed sharing rule is biased if we have infrequency, unless we have equal sharing. Consequently in section 5 we present results allowing for infrequency. Since this analysis is somewhat involved and relies on a number of auxiliary assumptions, the uncorrected values are presented here to provide a transparent alternative benchmark.

Table 2 presents the mean shares for each good and the distribution across the five allocation groups (the rows do not sum to 100 since some expenditures are not assigned). As discussed above, it is difficult conceptually to fit food into the private/public scheme and the respondents' answers reflect this - only 11.7% of food expenditures are allocated to a non-household group. More interesting are the responses on alcohol, tobacco and eating out ('vices'). Here 37.6% of total expenditures are assigned to the two partners and the husband has a share that is twice that of the wife. A detailed analysis of these patterns is given in the appendix. The clothing allocations show a familiar pattern to those seen in other expenditure surveys. The wife has a significantly higher share and, in our survey, the childrens' share is larger than that of the husband even though some households do not have children. As we expect, household services and transportation are mostly bought for the household. Transportation includes commuting costs and it is unclear whether respondents consider these as assignable (for her or him) or for the household. Recreation expenditures are slightly higher for husbands and significantly higher for children. Finally, personal services are largely assignable, with expenditures by wives that are three times as high as for husbands. These responses indicate that there is significant variation in the shares of assignable goods.

Despite the variation in allocations across goods, the shares of total expenditure given in the third last row of Table 2 indicate that husband and wife have similar total expenditures. We present a detailed analysis of the total shares in the next subsection. The final two rows of Table 2 give the annual cash amounts for each recipient group in Danish Kroner (DKK) and Euros. To give some perspective, average household disposable income is 301,202 DKK per year (= 40,160 Euros per year). Thus each partner spends about 5.5% of the money available to the household each month on their 'own' goods. Thus private expenditures constitute an important element in the household budget.

From the 'total share' row of Table 2 we see that the mean of the sharing rule (see equation (1)) in our raw data is 51.1%. Even though the mean is close to one half, there is considerable dispersion, as shown in figure 1, which gives the histogram for the wife's share of all expenditures that are assigned either to husband or wife. The very obvious censoring at 0 and 100 is due to infrequency (over a long period, everyone spends something on themselves for items such as clothing and personal care). The higher spike at unity simply reflects the fact that the wife is more likely to have some assignable

	For whom				
Good	Household	Husband	Wife	Children	Other
Food at home	79.3	3.5	2.9	4.2	1.1
Vices	53.6	24.8	12.8	4.2	3.1
Clothing	6.6	16.7	34.8	25.1	15.7
Household services	75.7	5.6	5.1	3.6	7.3
Transportation	62.2	18.1	14.2	3.4	0.6
Recreation	48.2	13.2	10.8	14.0	12.2
Personal services	33.1	11.6	33.9	13.3	6.7
Total share	57.3	13.7	14.3	9.5	5.2
Total (DKK)	67,888	16,497	17,282	12,429	6,650
Total (Euro)	9,052	2,200	2,304	1,657	887
The first eight rows give the percentage of the expenditure on the good that is spent by the recipient in the column heading.					

Table 2: Allocation within household

expenditure during the survey period. To take account of this infrequency and to estimate the marginal impact of different sharing variables on the sharing rule, we need to develop a statistical model; this is presented in the next section.

5 Allowing for infrequency.

5.1 The extent of infrequency.

One notable feature of the histogram for sharing rules shown above is how dispersed shares are. This could be wholly an artefact of the infrequency of purchase. To see this, note that even if the ‘long run’ sharing rule is the same for everyone ($\rho = 0.5$, for example) the observed values of the relative shares will vary simply because of infrequency. To investigate this and keep the analysis tractable we concentrate on the largely assignable goods and ignore food at home and household services. Also for tractability, we group transportation, recreation and personal services into one composite commodity, ‘other goods’. Thus we have three commodity groups: clothing, other goods and vices. Table (3) shows the proportion of positive reports for the two adults for each of these groups. As can be seen, some of the purchase

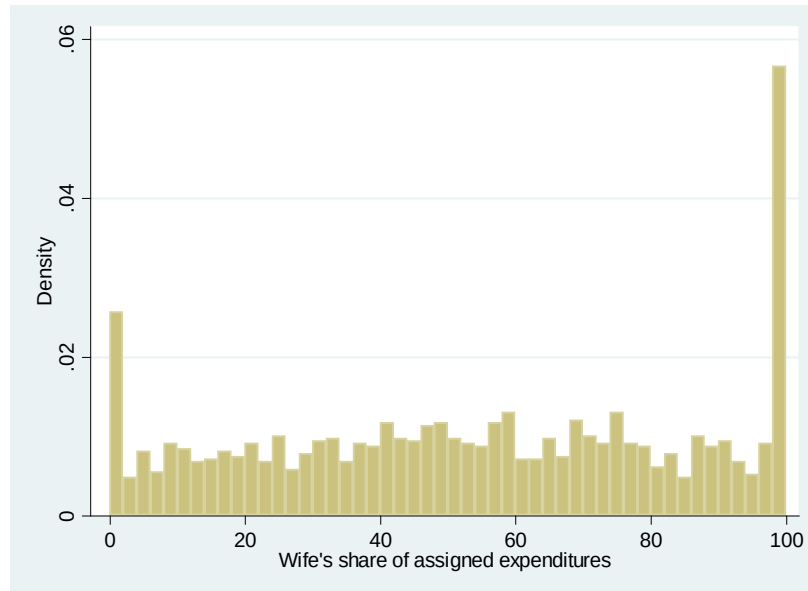


Figure 1: Observed wife's share in assignable expenditures.

probabilities are quite small, even for goods that are bought in the long run; men's clothing with a purchase frequency of 31.2% is an obvious example. We shall take the zeros for clothing and other goods as reflecting infrequency, but assume that the zeros for vices are a choice (a 'corner solution'). This is a reasonable assumption for tobacco, less reasonable for alcohol (given our two week diary period) and even less plausible for eating out. On the other hand, allowing that the zeros for vices reflect both a corner solution and infrequency is too difficult in the analysis below (and identification is fragile) so we prefer the corner solution assumption.

5.2 Identification with no infrequency problem.

To show clearly the structure we use, we begin by considering identification and estimation if we have one person, two goods ($i = 1, 2$) and there is no infrequency problem so that we observe the 'long run' purchases of each good, (x_1, x_2) . Following Pudney (1989) we assume that long run expenditures for these goods are lognormally distributed with the parameters depending on a vector of observables, $\mathbf{z}$, and unobservables. Thus long run purchases

Number	Good	(wife, husband)			
		(0, 0)	(+, 0)	(0, +)	(+, +)
1	Clothing	35.5	33.3	11.9	19.3
2	Other	8.2	21.5	6.8	63.6
3	Vices	23.1	11.4	25.0	40.5
‘Other’ is transportation, recreation and					
personal services.					

Table 3: Incidence of zeros

for these goods are always positive; this seems reasonable for clothing and other goods (which includes personal care products). Since the residuals in a demand system are correlated we employ a triangular factor scheme to capture heterogeneity given observables:

$$\begin{aligned} x_1 &= \exp(\mathbf{z}'\boldsymbol{\pi}_1 + \sigma_{11}U_1) \\ x_2 &= \exp(\mathbf{z}'\boldsymbol{\pi}_2 + \sigma_{21}U_1 + \sigma_{22}U_2) \end{aligned} \quad (7)$$

where U_1 and U_2 are independent standard Normals. If $\sigma_{21} = 0$ then the two expenditures, conditional on $\mathbf{z}$, are independent. If we can identify and estimate $\boldsymbol{\pi}_1$, $\boldsymbol{\pi}_2$, σ_{11} , σ_{21} and σ_{22} then we can simulate the demands which provides the basis for the estimation of our outcomes of interest. If we observed the (positive) x_i values then we could simply take logs of both sides of (7) and recover most of the the parameters from a regression, but below we have to take account of infrequency, which motivates the following estimator.

Since log Normal distributions are exactly determined by their first two moments, we consider only these. The first two moments of the two distributions (see Johnson, Kotz and Balakrishna (1994)) are given by :

$$\begin{aligned} E(x_1|\mathbf{z}) &= \exp(\mathbf{z}'\boldsymbol{\pi}_1 + 0.5(\sigma_{11})^2) \\ E((x_1)^2|\mathbf{z}) &= \exp(2\mathbf{z}'\boldsymbol{\pi}_1 + 2(\sigma_{11})^2) \\ E(x_2|\mathbf{z}) &= \exp(\mathbf{z}'\boldsymbol{\pi}_2 + 0.5((\sigma_{21})^2 + (\sigma_{22})^2)) \\ E((x_2)^2|\mathbf{z}) &= \exp(2\mathbf{z}'\boldsymbol{\pi}_2 + 2((\sigma_{21})^2 + (\sigma_{22})^2)) \\ E(x_1x_2|\mathbf{z}) &= \exp(\mathbf{z}'\boldsymbol{\pi}_1 + \mathbf{z}'\boldsymbol{\pi}_2 + 0.5((\sigma_{11} + \sigma_{21})^2 + (\sigma_{22})^2)) \end{aligned} \quad (8)$$

Nonlinear regressions of the levels and the squares and cross-products of x_1 and x_2 on $\mathbf{z}$ allow us to identify π_1 , π_2 , σ_{11} and σ_{21} and σ_{22} ; details of the estimation procedure are given below

5.3 Allowing for infrequency.

We now allow for infrequency of purchase. Let q_i be the observed quantity of good i bought in the sample period. If there is no infrequency of purchase (as we assume for vices) then we have $q_i = x_i$. Typically, however, we often observe no purchases in the sample period even though the agent does buy the good in other periods. Denote the probability of purchase of good i in the sample period by η_i . Following the literature (see Pudney (1989)) we take this probability to be fixed for each person and each good, but it may depend on covariates such as the survey month and the ownership of a car. Thus an agent sets $q_i = x_i/\eta_i$ in periods in which they purchase (and zero in other periods). The following gives two particularly useful results concerning the relationship between the (uncentred) moments of the distribution of observed purchases given a vector of characteristics $\mathbf{z}$ and the conditional moments of the distribution of (unobserved) long run purchases. The first result is an extension of the well known result that for one good the mean of the observed expenditure is equal to the mean of the long run expenditure.

Lemma 2 $E((x_i)^r | \mathbf{z}) = (\eta_i)^{(r-1)} E((q_i)^r | \mathbf{z})$.

This follows from:

$$\begin{aligned} E(q^r | \mathbf{z}) &= \eta E\left(\left(\frac{x}{\eta}\right)^r | \mathbf{z}\right) + (1 - \eta) E(0 | \mathbf{z}) \\ &= \eta^{(1-r)} E(x^r | \mathbf{z}) \end{aligned}$$

The next result shows that the mean product of two observed values is equal to the mean product of the long run values.

Lemma 3 $E(x_i x_j | \mathbf{z}) = E(q_i q_j | \mathbf{z})$.

The proof is given by:

$$\begin{aligned} E(q_i q_j | \mathbf{z}) &= \eta_i \eta_j E\left(\frac{x_i}{\eta_i} \frac{x_j}{\eta_j} | \mathbf{z}\right) + \eta_i (1 - \eta_j) E\left(\frac{x_i}{\eta_i} 0 | \mathbf{z}\right) \\ &\quad + (1 - \eta_i) \eta_j E\left(0 \frac{x_j}{\eta_j} | \mathbf{z}\right) + (1 - \eta_i) (1 - \eta_j) E(0 | \mathbf{z}) \\ &= E(x_i x_j | \mathbf{z}) \end{aligned}$$

These two results give that the conditional moments of the observed expenditures ($E(q_i|\mathbf{z})$ and $E((q_i)^2|\mathbf{z})$), the conditional moments of the product of observed purchases ($E(q_1q_2|\mathbf{z})$) and purchase frequencies (η_i) allows us to recover directly moments of the conditional distribution of the long run expenditures.

Combining this with (8) from the previous subsection we have:

$$\begin{aligned}
E(q_1|\mathbf{z}) &= \exp(\mathbf{z}'\boldsymbol{\pi}_1 + 0.5(\sigma_{11})^2) \\
E((q_1)^2|\mathbf{z}) &= \frac{1}{\eta_1} \exp(2\mathbf{z}'\boldsymbol{\pi}_1 + 2(\sigma_{11})^2) \\
E(q_2|\mathbf{z}) &= \exp(\mathbf{z}'\boldsymbol{\pi}_2 + 0.5((\sigma_{21})^2 + (\sigma_{22})^2)) \\
E((q_2)^2|\mathbf{z}) &= \frac{1}{\eta_2} \exp(2\mathbf{z}'\boldsymbol{\pi}_2 + 2((\sigma_{21})^2 + (\sigma_{22})^2)) \\
E(q_1q_2|\mathbf{z}) &= \exp(\mathbf{z}'\boldsymbol{\pi}_1 + \mathbf{z}'\boldsymbol{\pi}_2 + 0.5((\sigma_{11} + \sigma_{21})^2 + (\sigma_{22})^2)) \quad (9)
\end{aligned}$$

This gives a set of five equations for each of A and B which determine the parameters of interest, given the purchase probabilities and the parameterisation (??). Note that there is considerable over-identification from the cross-equation restrictions. For example, the vector $\boldsymbol{\pi}_1$ is identified from either of the first two equations. To find estimates of the purchase frequencies, η_i^A and η_i^B for $i = 1, 2$ we run a Probit for each partner and each good having a positive purchase that conditions on the month of the survey. Monthly dummies can certainly be excluded from the long run expenditure equations and are highly significant in the infrequency Probits, so that identification is secure. Given this we can simulate long run expenditures using (7). This will then allow us to construct estimates of the distribution of the sharing rule and the statistical and substantive dependence of the sharing rule on distribution factors.

5.4 Adding a third good.

As we discussed above we have a third good, vices, which we shall assume is not subject to infrequency. Thus we take the zeros we observe for vices to be choices. We shall model this using a Tobit framework:

$$x_3 = \max\{0, \mathbf{z}'\boldsymbol{\beta} + e\} \text{ with } e \sim N(0, (\sigma_3)^2) \quad (10)$$

To allow for dependence between the residuals in the three goods we employ a control function approach, see Blundell and Powell (2004). To do this we

extend the definitions of the mean functions in (??) to include the residual from the third good:

$$\begin{aligned} \mathbf{z}'\boldsymbol{\pi}_1 &\rightarrow \mathbf{z}'\boldsymbol{\pi}_1 + \theta_1 e \\ \mathbf{z}'\boldsymbol{\pi}_2 &\rightarrow \mathbf{z}'\boldsymbol{\pi}_2 + \theta_2 e \end{aligned} \quad (11)$$

We use a two step procedure to estimate. First we estimate the parameters β using a conventional Tobit and then generate generalised residuals for person h :

$$\hat{e}_h = \mathbf{1}(x_{3h} > 0) \left(x_{3h} - \mathbf{z}'_h \hat{\beta} \right) - \mathbf{1}(x_{3h} = 0) \left(\hat{\sigma}_3 \frac{\phi \left(-\mathbf{z}'_h \hat{\beta} / \hat{\sigma}_3 \right)}{\Phi \left(-\mathbf{z}'_h \hat{\beta} / \hat{\sigma}_3 \right)} \right) \quad (12)$$

where the functions $\phi(\cdot)$ and $\Phi(\cdot)$ are respectively the pdf and cdf of the standard Normal. In the second step we add the generalised residuals to the regressors in (9), as shown in (11), and estimate the system (9).

In practice we have to model the expenditures of both A and B and generate two generalised residuals. In doing this we explicitly allow that the error terms in the two equations defined by 10 are correlated since it seems plausible that the unobservable tastes for tobacco and alcohol are correlated across the partners. Rather than estimating a joint Tobit we also use the control variable approach here and include the generalised residual for A in the equation for B :

$$\begin{aligned} x_{3A} &= \max \{0, \mathbf{z}'\beta_A + e_{3A}\} \text{ with } e_A \sim N(0, (\sigma_{3A})^2) \\ x_{3B} &= \max \{0, \mathbf{z}'\beta_B + \delta \hat{e}_{3A} + e_{3B}\} \text{ with } e_B \sim N(0, (\sigma_{3B})^2) \end{aligned} \quad (13)$$

We include both of the generalised residuals in the equations for goods 1 and 2 for both partners. The system parameters are estimated by GMM using the orthogonality conditions derived from (9). For example for the first condition for person A we have, for each element z_k of $\mathbf{z}$:

$$\frac{1}{H} \sum_{h=1}^H z_{kh} \left(q_{A1h} - \exp \left(\mathbf{z}'_h \boldsymbol{\pi}_{A1} + \theta_{AA} \hat{e}_{3A} + \theta_{AB} \hat{e}_{3B} + 0.5 (\sigma_{11}^A)^2 \right) \right) \quad (14)$$

where z_{kh} is the value of the k th $\mathbf{z}$ variable for household h and q_{A1h} is the observed expenditure on good 1 for person A in household h . The system (9) thus gives five orthogonality conditions for each $\mathbf{z}$ variable for each partner. The optimal weighting matrix is constructed using first round estimates with an identity weighting matrix (that is, weighting each of the five conditions equally).

5.5 Outcomes of interest.

Given the statistical procedure above the distribution of the sharing rule (which is a ratio of convolutions) is analytically intractable. Consequently we use simulations of the sharing rule to generate outcomes of interest. To simulate we take the parameters estimated as described above. For each synthetic couple we draw 6 independent standard Normal random variables $U_1^A, U_2^A, U_3^A, U_1^B, U_2^B, U_3^B$. For a given demographics vector $\mathbf{z}$ we generate the three long run demands using:

$$\begin{aligned}\hat{x}_1^A &= \exp\left(\mathbf{z}'\hat{\boldsymbol{\pi}}_1^A + \hat{\theta}_{AA}\hat{\sigma}_3^A U_3^A + \hat{\theta}_{AB}\hat{\sigma}_3^B U_3^B + \hat{\sigma}_{11}^A U_1^A\right) \\ \hat{x}_2^A &= \exp\left(\mathbf{z}'\hat{\boldsymbol{\pi}}_2^A + \hat{\theta}_{AA}\hat{\sigma}_3^A U_3^A + \hat{\theta}_{AB}\hat{\sigma}_3^B U_3^B + \hat{\sigma}_{21}^A U_1^A + \hat{\sigma}_{22}^A U_2^A\right) \\ \hat{x}_3^A &= \max\left\{0, \mathbf{z}'\hat{\boldsymbol{\beta}}^A + \hat{\sigma}_3^A U_3^A\right\}\end{aligned}\tag{15}$$

and similarly for B . Given these simulated values, we calculate the sharing rule by:

$$\hat{\rho}(\mathbf{z}) = \frac{\hat{x}_1^A + \hat{x}_2^A + \hat{x}_3^A}{\hat{x}_1^A + \hat{x}_2^A + \hat{x}_3^A + \hat{x}_1^B + \hat{x}_2^B + \hat{x}_3^B}\tag{16}$$

This will then allow us to generate simulated distributions of the sharing rule using the observed variation in $\mathbf{z}$ in the data; the distribution conditional on a particular value of $\mathbf{z}$; the marginal influence of any variable and the significance of any variable or marginal effect in the sharing rule (using a bootstrap procedure described below). Note that a variable in the vector $\mathbf{z}$ might be highly significant in one or more of the demand equations but wholly insignificant in the sharing rule; see proposition 1.

The conditional distribution of the sharing rule is given by the simulation (16) with the $\mathbf{z}$ values set at the mean in the data and random draws for $U_1^A, \dots, U_3^B$. This is the primary object of interest. We also present some moments of this distribution with (bootstrap) confidence intervals to give some idea of the precision of our estimates. To assess the dependence of the sharing rule $\rho(\mathbf{z})$ on sharing factors, we define the *marginal effect* of factor z_k on the sharing rule to be:

$$\hat{m}_k(\mathbf{z}) = \frac{\partial \hat{\rho}(\mathbf{z})}{\partial z_k}\tag{17}$$

where $\mathbf{z}$ is fixed at the mean of the data.⁸ We shall also present bootstrapped t-values for these marginal effects.

6 Results with corrected data.

6.1 Sharing variables.

To implement the estimator discussed in the last section we use a long list of variables to model expenditures on each good; these are listed in Table 4. Many of these variables have been considered in previous studies of intra-household allocation; for example, the first five variables ('lnety' to 'dlginc') were considered in Browning *et al* (1994) and several papers that followed. Other variables in Table 4 have never been considered in the empirical intra-household allocation literature. In particular, the background variables such as the dummies for having had a previous marriage (which includes cohabitation), previous children and the work status of the respondent's mother when the respondent was 14. The difference between the value for having children present in the household ('dnoch') and the dummy for having children together ('commch') is because some older couples have joint children who have left home and some other households have children in the household who are not children of both partners. As can be seen, having more than one marriage is relatively common in Denmark (particularly bearing in mind that some of the couples in our sample are young and will have other partners later) but having children from before the current marriage ('hpch' and 'wpch' for husband and wife respectively) is less common. This list of 16 variables comprise the $\mathbf{z}$ variables of the last section (along with a constant). In the Probit for infrequency we include these variables and also 11 survey month dummies and dummies for owning a car and for living in a rural area.

The test statistics for the overidentifying restrictions for the GMM estimation for goods 1 and 2 for A and B (see the remark following (9)) are 45.8 and 27.6 respectively. Since each system has 41 parameters and 85 instruments⁹ (giving 44 degrees of freedom) we do not reject the cross-equation

⁸An alternative to this is to present marginal effects for discrete changes. For example, for a variation from the first to third quantile for continuous variables and for a variation from zero to unity for discrete variables. In practice, the difference between the two types of estimates (properly normalised) turned out to be very small, so we choose to present only the derivative form.

⁹For each partner we have 17 z_j variables in (14) (including the constant) and we have

Name	Description	Mean
lnety	log net household income	1.15
dnoch	dummy variable for no children present in household	0.46
agediff	wife’s age minus husband’s age (in decades)	−0.21
eddiff	difference in years of schooling	−0.10
dlginc	difference in log annual gross income	−0.35
lymarr	log years of current partnership	2.20
hpmarr	dummy for husband previously married	0.55
wpmarr	dummy for wife previously married	0.54
hpch	dummy for husband having previous children	0.15
wpch	dummy for wife having previous children	0.14
commch	dummy for having common children	0.66
hmothf	Husband’s mother full time employed when he was 14	0.41
wmothf	Wife’s mother full time employed when she was 14	0.42
hage	Husband’s age (decades)	3.99
hyears	Husband’s years of schooling	11.9
hginc	Husband’s log gross income	3.19

Table 4: List of sharing factors

restrictions in (9). Since the expenditure equations conditional on these variables do not have any structural interpretation (for example, we include measures of household net income and the husband’s gross income) we do not present the details of the individual estimates. Instead we move directly to a consideration of the main focus of this paper: the level and determinants of the sharing rule.

6.2 The level and distribution of the sharing rule.

The first (and most important) result concerns the distribution of the sharing rule. To find this we draw 100,000 sets of 6 random numbers (one for each good) and calculate the sharing rule for each set using the parameter estimates for the six goods with the independent variables from Table 4 set at their mean values. The implied distribution is given in figure ???. This is to be compared to the uncorrected distribution given in the top panel of figure 1. The most obvious difference is that the mass points at zero and unity

5 orthogonality conditions, giving 85 ‘instruments’.

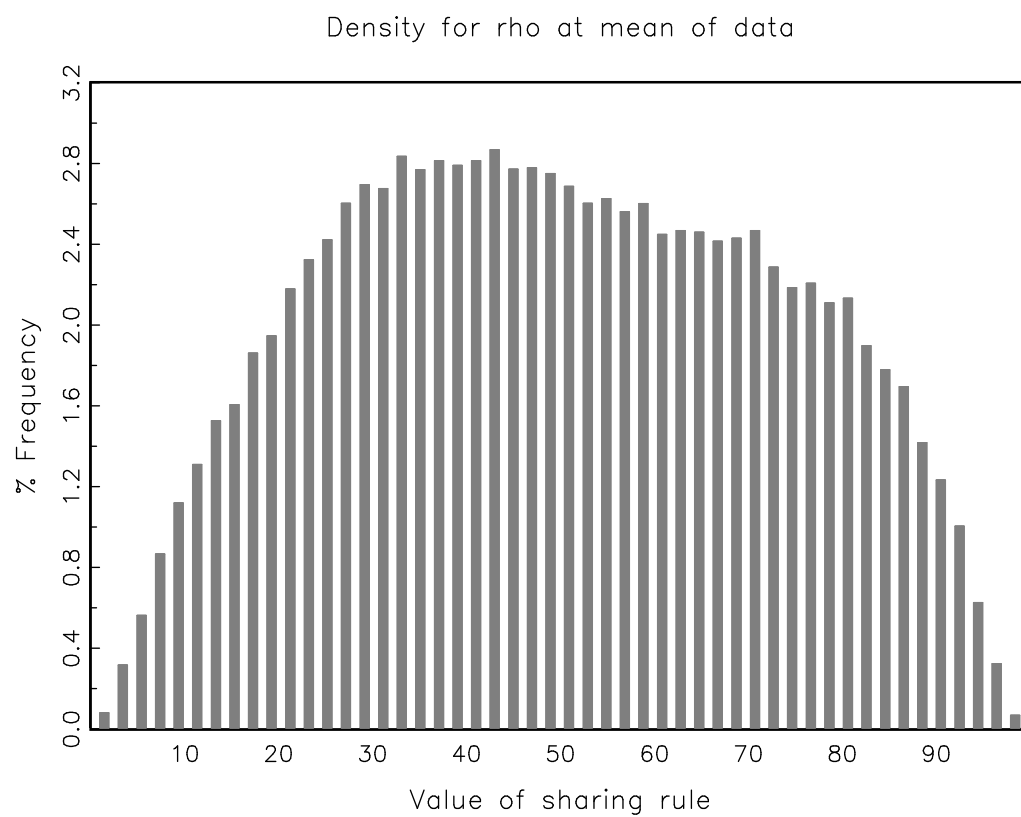
have disappeared and the distribution is obviously unimodal. The mean of the corrected data is 49.7. This is close to the uncorrected value since equal sharing implies that the uncorrected sharing rule is an unbiased estimator of the true sharing rule (see the remarks following (6)). Despite this equality between partners at the mean, figure ?? provides strong evidence of considerable inequality within some households; for example the first and third quantiles of the distribution of the sharing rule are 31.3 and 68.4 so that close to half of households have one partner receiving twice as much as the other.

Next we consider the precision of these estimates. To do this we first bootstrap the estimation procedure. We draw 2,000 new samples by sampling with replacement from the household data. Then we re-estimate the parameters for the six goods for each of the 2,000 synthetic data sets. To keep the analysis computationally feasible we adopt the suggestions of Davidson and McKinnon (1999) and Andrews (2002) and only allow a limited number of Newton steps for each bootstrap replication. For each of these estimates we calculate the sharing rule for 10,000 synthetic households (just as in the previous paragraph, except we take a smaller number of replications to keep the analysis numerically feasible). The random numbers for these synthetic households are kept constant across bootstrap replications. For each of the bootstrap replications we take the mean of the sharing rule over the 10,000 synthetic households. The distribution of this is the simulated analogue of the distribution of the mean sharing rule. The mean and standard deviation of the bootstrapped means are 50.3 and 1.2 respectively. Thus the mean of the sharing rule is well determined, with a 95% confidence interval (from the bootstrap distribution) of (48.0, 52.6).

This establishes the most important conclusion in this paper: the mean sharing rule is precisely determined and not significantly different from one half but the sharing rule is quite dispersed over the population. The next issue we address is what causes this dispersion.

6.3 The determinants of the sharing rule.

In Table 5 we present the estimates and t-values for the marginal effects of the variables from Table 4. To generate the estimates we take the derivatives of the sharing rule at the mean of the data for each of 10,000 replications (as in the calculation of the distribution of the sharing rule but with fewer replications since we have to take calculate a gradient vector for each replication). We then take the mean over these values to give the estimated



marginal effect. To calculate the t-values we estimate the same derivatives for each bootstrap replication and then use the covariance matrix of these 2,000 bootstrap replications as the covariance matrix for the estimates of the derivatives. As can be seen, some variables are ‘significant’ and others are not. Since many of the variables are highly co-linear (for example, the dummies for having children present in the household and for having had children together) we remove some variables to find a preferred specification. To do this, we simply removed the ‘least significant’ (the lowest t-value) variable, one at a time, until we have small number of variables that individually have a t-value of at least 1.8. To estimate with a smaller set of variables we use a minimum distance estimator with the bootstrap covariance matrix as the weighting matrix.

The preferred restricted set of estimates is given in the second set of columns in table 5; the $\chi^2(10)$ statistic for the exclusion of the left out variables is 11.0. We are left with 6 variables. Some of these are familiar in the intrahousehold allocation literature and some are wholly novel. The variables for the husband’s schooling (‘hyears’) suggest that women receive a higher share in high education households; the effect, however is small with an increase of only 2.8 percentage points as we move from 12 years of schooling to 16 years of schooling. The estimates for the effects of the difference in log gross incomes (‘dlginc’) and the husband’s log gross income (‘hginc’) imply that the wife’s share increases with any increase in joint gross income with the effect being stronger for her income than for his. For example, suppose that husband and wife initially have the same gross income. Now increase her income by 50%; the implied increase in the wife’s share in expenditures is 1.85 percentage points. If, by contrast, his income increases by 50% then the increase in her share is only 0.62 percentage points.

Of most interest (because they have never been used in this context before) are the background variables on whether the partners have children from before the marriage (‘hpch’ for the husband and ‘wpch’ for the wife) and whether the husband’s mother was in full-time employment when he was 14 (‘hmothf’). The effects of having a previous child have the same sign so that a wife who has had a previous child and is married to a man who has also had a previous child receives a share that is about nine percentage points lower than an otherwise comparable women in which neither partner has children from before the marriage. This is far and away the largest effect we find in our analysis. It is important to emphasise that these effects are *not* proxying for, for example, age, the number of years the couple have been

together or being previously married, since we control for these in the general analysis. We do not know of any theory model that predicts that having a previous child impacts on current sharing in the way we find (that is, previous children make husbands better off and wives worse off). On the other hand, the finding that the husband having grown up in a household in which his mother was in full-time employment increases his share of expenditure is consistent with the theory model and empirical results reported in Fernandez *et al* (2004). Broadly, such men make more desirable husbands (perhaps because they contribute more in housework) and hence do better in any match than an otherwise similar male who does not have this background.

The final two columns of Table 5 gives the results using the general specification considered in Browning *et al* (1994) (BBCL) who base their empirical analysis on a comparison of spending on clothing by Canadian couples. The χ^2 statistic for the exclusion of the 11 variables at the end of the list is 59.3 so that we decisively reject the BBCL formulation. The results for some of these variables are similar to BBCL (for example there is a positive effect of household income and the wife's share of income on her share of expenditures) and other results are different (for example, the insignificance of the difference in age). We conclude from this comparison that some of the differences we find to previous investigators are because we have a wider set of variables and others seem to be due to having different (and much weaker) identifying assumptions.¹⁰

7 Conclusions.

The paper presents, for the first time, direct survey information on the sharing of *all* expenditures within the household. The main observable determinants of the variation in sharing expenditures across couples are a mixture of variables found in previous studies and variables that have not been considered before. As regards the former, we find that wives in higher educated and/or higher joint income households have a higher expenditure share. The other familiar effect is that the wife's share of assignable expenditures is increasing in her share of gross income. Turning to variables that have not

¹⁰It would be desirable to run the Browning *et al* procedure using only clothing on our data set to pin the exact reason for the difference in results. Unfortunately the survey designs are different since the Canadian family expenditure survey data used in that paper gives *annual* expenditures and hence is much less troubled by infrequency.

	Unrestricted		Restricted		BBCL	
Name	Coeff	t-value	Coeff	t-value	Coeff	t-value
constant	-8.68	3.2	-7.56	3.3	-3.12	1.7
lnety	-1.96	1.0	—		3.48	2.3
dnoch	-1.52	0.9	—		0.20	0.1
agediff	2.34	1.4	—		0.53	0.4
eddiff	-0.09	0.3	—		-0.43	1.3
dlginc	3.68	2.8	3.70	3.3	1.42	1.2
lymarr	-1.48	1.3	—		-	
hpmarr	2.79	1.8	—		-	
wpmarr	-0.79	0.5	—		-	
hpch	-3.71	1.3	-3.08	2.0	-	
wpch	-7.04	4.4	-5.67	3.8	-	
commch	-1.15	0.7	—		-	
hmothf	-2.20	1.7	-2.24	1.8	-	
wmothf	1.56	1.2	—		-	
hage	2.52	2.1	—		-	
hyearsc	0.53	1.8	0.70	2.9	-	
hginc	4.63	2.6	4.94	3.1	-	
# variables	17		7		6	

Table 5: List of distribution factors

previously been considered in the literature, we find that some of these are highly significant and also have a strong impact on sharing. If the husband had a mother who was in full-time employment when he was aged 14 then he receives 2.24 percentage points more of assignable expenditure than if his mother was not employed full-time. The strongest effect is also the most puzzling. If the wife has a child who is not the natural child of her partner then she receives six percentage points of assignable expenditure less than an otherwise comparable woman. It is not difficult to think informally of theory models that might give this. On the other hand, men do *better* if they have a previous child. This asymmetry in the effects of having a previous child await a theoretical explanation.

Our most important finding is that the mean share that wives have of all expenditures that are assignable to husband or wife is well determined and very close to one half. We also find that there is considerable dispersion across the population with half of households having that one partner receives twice (or more) as much as the other. Moreover, these expenditures comprise a sizable part of the household budget. For example, the mean joint expenditure by husbands and wives on their own private, assignable goods accounts for 11% of disposable income. In this paper we have not presented any models for the facts we have uncovered. The obvious next step is to use the data to distinguish between the different theories that have been suggested in the literature.

Good	Shares of consumption			(wife, husband)			
	Household	Husband	Wife	(0, 0)	(+, 0)	(0, +)	(+, +)
Alcohol	64.8	16.8	4.2	46.9	4.8	19.1	29.3
Tobacco	26.7	43.6	26.2	9.8	10.3	19.6	60.3
Eating out	53.4	21.6	12.9	26.7	11.6	22.5	39.2
Note: shares do not sum to 100 since ‘children’ and ‘other’ excluded.							

Table 6: The allocation of vices expenditures

A Proof of proposition 1.

The sufficiency is obvious. To show necessity, first suppose that we have only one element in $\mathbf{w}_N$ so that both x_A and x_B are functions of $(\mathbf{w}_S, w_N)$. Take the partial derivative through 1 with respect to w_N . By definition this is zero, so that (after some algebra) we have:

$$\frac{\partial x_A}{\partial w_N} x_B = \frac{\partial x_B}{\partial w_N} x_A \Rightarrow \frac{x_A(\mathbf{w}_S, w_N)}{x_B(\mathbf{w}_S, w_N)} = k(\mathbf{w}_S) \quad (18)$$

which gives the form in the proposition with $k(\mathbf{w}_S) = \phi^A(\mathbf{w}_S) / \phi^B(\mathbf{w}_S)$. If we now allow for a vector $\mathbf{w}_N$, repeated use of the same argument gives the general form.

B The distribution of expenditures on vices.

Table 6 presents a breakdown of the shares for vices. As we might expect, tobacco is considered more assignable than alcohol or eating out. The 26.7% share for the household for tobacco presumably reflects tobacco products that both consume. There are few households in which the wife consumes alcohol but not the husband whereas the converse is more common.

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