Working Paper No. 20110

Who Wears the Pants in the Family:  
Power Distribution in Family Consumption

by

David Just,
David Zilberman
and
Amir Heiman
Who Wears the Pants in the Family: Power Distribution in Family Consumption.

David Just  
Graduate Researcher  
Department of Agricultural and Resource Economics  
University of California  
Berkeley, CA 94720-3310  
just@are.berkkeley.edu

David Zilberman  
Professor  
Department of Agricultural and Resource Economics  
University of California  
Berkeley, CA 94720-3310

Amir Heiman  
Lecturer  
Department of Agricultural Economics and Management  
Hebrew University  
Rehovot Israel

August 26, 2001

Abstract
This paper combines the Becker family production model with a cooperative bargaining model to analyze power distribution within the family. Family consumption decisions are often made by one person, but for several people, suggesting that traditional demand theory may be inadequate. Using data gathered in Israel, we show the significance of family relationships in purchasing behavior.
Who Wears the Pants in the Family: Power Distribution in Family Consumption.

Michael and Becker (1973) criticized demand theory as placing too little weight on preferences, time, and effort required to use products. They proposed a model of family consumption based on a family production function, and a family utility function. However, a family usually involves several people with heterogeneous preferences, which raises the question: how do individual preferences within the family influence family purchases. Do individuals purchasing for a family make decisions biased toward their own preferences? Is there evidence that these purchases are a result of power struggles within the family? How might sociological factors such as religion affect purchasing habits?

In this paper we estimate the extent to which purchasing behavior in meat consumption represents the preferences of each individual in the family. In doing this we take an approach somewhat separated from the traditional family production, or demand estimation literatures. Our primary departure is the use of survey data on preferences of family members. Most studies to date estimate preferences using observations of prices and consumption. Instead we estimate parameters of utility functions and family power distribution using observations of prices consumption and preferences.

Price and income accounting for less than half of consumption variation (Michael and Becker 1973). A complete theory of consumption must therefore include a theory of preference formation, and would account for non-market goods such as family production. Decision-making activity involving the purchase of goods and services
within a family appears to be more of an outcome of joint decision making than ever before (Burns, 1992). Many purchasing decisions are not the outcome of an individual choice, and because husbands and wives typically do not have identical wants and needs, it can be expected that joint decision-making may often involve some level of conflict. In families that involve children, the children likely control a portion of, and influence the majority of the remaining, purchasing decisions within a family (see Lackman and Lanasa, 1993).

Manser and Brown (1980) and McElroy and Horney (1981) proposed cooperative models to explain household resource allocation decisions. These models were based on the idea that noncooperation would result in divorce. More recently Lundberg and Pollak (1993) based their model on the possibility of noncooperation within a marriage not resulting in divorce. The model we construct allows all members of the family to influence decisions affecting resource allocation. More importantly, this approach allows for direct estimation of each individual's power within the family. Further, this approach allows for children's power to differ across parents. Thomas (1991) found that mothers’ incomes are highly correlated with nutrition measures of children, while the correlation is much weaker with fathers’ incomes. Our analysis further demonstrates that traditional demand theory is inadequate as a model of family consumption. Given the volume and percentage of purchases made within a family or other group setting, particularly in agricultural consumption, it is very worthwhile to explore the differences between individual and group purchasing decisions.

To address these issues a survey was conducted. The survey includes data on preferences of each family member over meat products, the number of meals in which
each product is used, which family member usually makes food purchases and the
enjoyment received from cooking, and the family feedback given to the cook. The
survey also included demographic data such as income level and the extent of religious
observance. It should be noted that intensity of religious practice in Israel places
constraints on food consumption habits. These data provide the information necessary
for estimation of family members' relative power within the family. Using these data,
family purchasing is modeled as a cooperative game by combining components of
Becker's model of family consumption and a bargaining model similar to Zusman's
(1976). Zusman’s original model employs a Harsanyi-Nash bargaining equilibrium to
describe the influence of special interests on the Israeli parliament. Specifically this
approach allows the one who is making decisions for the family to be affected by others'
power and influence. The advantage of this approach is that it allows for estimation of
the strengths of influence of each family member, and testing whose preferences are best
represented by purchases made for the whole family.

We find that parents give weights to various family members’ preferences that
are similar in order of rank, but differ in magnitude. Both parents, when shopping, give
the greatest weight to their own preferences, and strong weight to their spouse’s
preferences. The children trail the parents in their power weights. Mother’s give much
higher weight to their own preferences leaving fathers and children with little influence
when the mother shops. Fathers tend to distribute power more evenly among spouse and
children, while still maintaining the largest share of the power.

The Model
According to the Becker model, the family uses income to buy goods like meats and then combines these goods with time to produce commodities, or in this case meals. Thus the family production function for each meal can be specified as

\[ y = f(x, t), \]

where \( x \) is the vector of goods, and \( t \) is a vector of time used in production of each meal. For simplicity we will assume that family production is additively separable in inputs, and one and only one type of meal can be produced from each meat, so

\[ y = (y_1, \ldots, y_M) = (f_1(x^1, t^1), \ldots, f_M(x^M, t^M)). \]

where \( M \) is the number of meals that are possible to make. Thus, within the framework of the Becker family production model, the family must solve the problem

\[
\max_{x, t} U(f(x, t), t_0) \quad \text{subject to} \quad \sum_{m=1}^{M} (P^m x^m) + wt^m + wt_0 = I + wT,
\]

where \( U \) is the family utility function, \( P^m \) is the price of the \( m \)th good, \( x^m \) is the amount of the \( m \)th meat used (or the meat that is used to make the \( m \)th meal), \( w \) is the wage rate where we assume only one uniform wage rate for each member of the family, \( t_0 \) is the amount of time used in leisure, and \( t^m \) is the amount of time used to produce \( y^m \), \( I \) is the endowment of income, and \( T \) is the endowment of time.

This leaves the question of how to formulate the function \( U \). We begin addressing this question by considering a family of \( K \) members. Member \( c \) does all of the cooking, and member \( s \) does all of the shopping. The same person may do both
cooking and shopping, \( c = s \). We can then specify each individuals’ utility of food consumption as:

\[
\begin{align*}
  v_k(y) & \quad \text{where } k \neq c \\
  v_c(y, t) &
\end{align*}
\]

where \( y \) is a vector of meals, and \( t \) is the time used to prepare the meals in vector \( y \). This model assumes that the decision as to who is shopping is predetermined and shopping requires the same amount of time no matter which meats are purchased.

The shopper is a single decision-maker who may be affected by others threats of noncooperation in other aspects of life in accordance with a Harsanyi-Nash equilibrium (Harsanyi 1962). It may be a child who refuses to eat or who causes problems for the family in other ways. It could also be that the shopper buys food to win the affection of his or her spouse. Although no explicit assumptions are necessary regarding noncooperative equilibria, it is unlikely that poor food shopping decisions would result in divorce. By solving for the Harsanyi-Nash bargaining solution, a coefficient of power can be estimated for each family member. Using this solution, family utility can be represented as

\[
U(y(t), t_0) = \sum_{k=1}^{K} \beta_k v_k
\]

where \( \beta_k \) is the influence the \( k \)th member of the family has over member \( s \), and \( v_k \) is individual \( k \)'s utility function over meat consumption and time as defined earlier in (1). Note that (3) cannot be interpreted as family utility, only the objective function leading
to the Nash bargaining solution. Substituting equation (3) into (2) and stating the problem as a LaGrangian

(4) \[ L = \sum_{k=1}^{K} \beta_k v_k + \lambda \left[ I + wT - \sum_{m=1}^{M} \left[ P^m x^m + wt^m \right] - wt_0 \right] \]

Differentiating (4) obtains the first order conditions for the constrained maximum:

(5) \[ \frac{\partial L}{\partial x^m} = \sum_{k=1}^{K} \beta_k \frac{\partial v_k}{\partial y^m} \frac{\partial y^m}{\partial x^m} - \lambda P^m = 0, \quad \text{for } m = 1, \ldots, M \]

(6) \[ \frac{\partial L}{\partial t^m} = \sum_{k \neq c} \beta_k \frac{\partial v_k}{\partial y^m} \frac{\partial y^m}{\partial t^m} + \beta_c \frac{\partial v_c}{\partial y^m} \frac{\partial y^m}{\partial t^m} + \beta_c \frac{\partial v_c}{\partial t^m} - \lambda w = 0, \quad \text{for } m = 1, \ldots, M \]

(7) \[ \frac{\partial L}{\partial t_0} = \beta_c \frac{\partial v_c}{\partial t_0} - \lambda w = 0 \]

(8) \[ \frac{\partial L}{\partial \lambda} = I + wT - \sum_{m=1}^{M} \left[ P^m x^m + wt^m \right] - wt_0 = 0. \]

Combining equations (6) and (7) above yields

(9) \[ \sum_{k=1}^{K} \left( \beta_k \frac{\partial v_k}{\partial y^m} \frac{\partial y^m}{\partial t^m} \right) + \beta_c \frac{\partial v_c}{\partial y^m} \frac{\partial y^m}{\partial t^m} = \beta_c \frac{\partial v_c}{\partial t_0}. \]

This is similar to the requirement that marginal benefit from time used by the cook in meeting family agreements must equal the marginal benefit from increased leisure time.

Combining equations (5) and (7) obtains

\[ \sum_{k=1}^{K} \left( \frac{\beta_k}{P^m} \frac{\partial v_k}{\partial y^m} \frac{\partial y^m}{\partial x^m} \right) - \frac{\beta_c}{w} \frac{\partial v_c}{\partial t_0} = 0, \quad \forall m. \]
This is similar to requiring marginal utility of meat purchasing and leisure time be equal, because the first term is the price adjusted marginal utility of consumption, and the second is the price adjusted marginal disutility of cooking. Combining (9) and (10) and rearranging obtains

\[
\sum_{k=1}^{K} \beta_k \frac{\partial v_c}{\partial y^m} \left( \frac{w \frac{\partial y^m}{\partial x^m} - \frac{\partial y^m}{\partial t^m}}{P^m} \right) = 1.
\]

In order to simplify, we make the following assumptions:

1. Individuals preferences can be represented as

\[
v_k(x) = \sum_{m=1}^{M} \alpha_m^k \log \left( x^m - v^m(z) \right), \quad \text{for } k \neq c
\]

\[
v_c(x, t) = \alpha_c^c \log \left( \sum_{m=1}^{M} t^m \right) + \sum_{m=1}^{M} \alpha_m^k \log \left( x^m - v^m(z) \right).
\]

where \( v^m(z) \) is a parameter common to all family members, and \( z \) is a measure of sociological influences.

2. Within a family, time required to produce one unit of a meal containing a particular meat is fixed.

3. Within a family, each meal requires exactly identical amounts of meat (no matter which meat).
Assumption 3 requires that $\frac{\partial y^m}{\partial x^m} = \gamma$. This means that each meal requires a constant amount of meat (no matter which meat). Assumption 2 requires that $\frac{\partial y^m}{\partial t^m} = \xi_m$. This equation means that there are constant returns to time in production of each meal. Productivity of time does, however, depend on which meal is produced. These assumptions allow us to rewrite (8) and (11) as

\begin{equation}
I + wT - \sum_{m=1}^{M} \left( P^m x^m + wt^m \right) - wt_0 = 0
\end{equation}

\begin{equation}
\sum_{k=1}^{K} \left[ \beta_k \frac{\partial y_k}{\partial y^m} \left( \frac{w}{P^m \gamma - \xi_m} \right) \right] = 1
\end{equation}

Assumption 1 implies preferences are of a modified Stone-Geary form. The parameter $\nu^m$ allows family members to experience positive utility despite not consuming one of the meats. This parameter, often interpreted as the minimum consumption level when negative, can be interpreted here as a measure of utility in the absence of consumption. We require $x^m - \nu^m$ to be non-negative. Food is not consumed solely for dietary values, but is often an ethnographic activity. It can be said to help define social identity (see Gans 1994). Thus we expect $\nu^m$ to be influenced by sociological characteristics and religious identity.
Religious observance has been shown to affect the economic choices of individuals. This includes the choice of foods. Bell (1968) found a change in Catholic dietary rules to have significant affects on fish consumption in the U.S. Since many of the kosher rules were written two thousands years ago there is a need to interpret them and adapt them to modern life. Shatenstein, Ghadirian and Lambert (1993) showed empirically that the consumption of meats vary between orthodox Jews and explain it in the openness of the society to the secular community. Jewish law includes several rules governing the constitution and combinations of foods that can be eaten. Kosher rules differ according to how observant families are, and which Jewish tradition has been adopted by the family. Along with various practices there are various religious councils that monitor and certify foods. More observant Jews may avoid some mass produced foods perceiving the religious certification to be unreliable or inadequate for their own beliefs. Further some rules govern which meats can be eaten in which parts of the week. Restrictions of this nature will likely affect consumption behavior. This is the affect we hope to capture in $v^m$.

While we require each family member to have the same parameter $v^m$, each individual’s utility function raises $v^m$ to a different power corresponding to that individual’s preference for meat $m$. Substituting the functional form in assumption 1 back into equations (14) and (15) yields

$$I + wT - \sum_{m=1}^{M} (P^m x^m + wt^m) - wt_0 = 0$$
Equation (17) can be rearranged to yield the demand equation

$$
(17) \quad \sum_{k=1}^{K} \left[ \beta_k \frac{\alpha_m^k}{x^m - y^m(z)} \left( \frac{W}{P^m \gamma - \xi_m} \right) \right] = 1
$$

$$
\frac{\beta_c \alpha_c^c}{\sum_{m=1}^{M} t^m}
$$

Equation (17) can be rearranged to yield the demand equation

$$
(18) \quad x^m = y^m(z) + \left( \frac{\sum_{m=1}^{M} t^m}{\sum_{k=1}^{K} \beta_k \alpha_m^k \left( \frac{W}{P^m \gamma - \xi_m} \right)} \right)
$$

which is the object of our estimation. Equation (18) shows the trade off between cooking and consumption utility. The numerator of the second term may be interpreted as the marginal utility of shifting a dollar of resources from time in cooking to meat purchasing, and the denominator is the marginal utility from an extra hour of cooking.

**The Survey and Data**

The data was collected in a survey of 407 households in Israel. Survey households were chosen and interviewed face to face within their own homes. The response rate was high (93%), and demographics of respondents (gender, religion, and income) is quite representative of Israel's shoppers as a whole. The survey itself took 12 to 18 minutes to complete. For each family, the member of the household who did more of the shopping was interviewed about several factors influencing meat purchases. Among these factors are number of family members, each member’s preference for each meat, income level, the cook's preference for cooking, time used in cooking, and leisure.
Families were also asked about the age of each child.

In order to measure consumption of each meat, respondents were asked about the number of meals they eat each week including (unprocessed) chicken, (unprocessed) turkey, processed chicken, processed turkey, beef, and ready-to-eat meals. Table 1 contains summary statistics for shares of each meat calculated from the frequencies for each family. We present shares here because they are easier to interpret than actual consumption. In estimation we used the recorded frequency of each meat for each family.

Table 1: Summary Statistics for Shares of Meat Consumed

<table>
<thead>
<tr>
<th>Meat</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td>.2913</td>
<td>.1562</td>
<td>.0000</td>
<td>1.0000</td>
<td>407</td>
</tr>
<tr>
<td>Turkey</td>
<td>.1219</td>
<td>.1131</td>
<td>.0000</td>
<td>.5000</td>
<td>407</td>
</tr>
<tr>
<td>Processed Chicken</td>
<td>.1936</td>
<td>.1155</td>
<td>.0000</td>
<td>.5714</td>
<td>407</td>
</tr>
<tr>
<td>Processed Turkey</td>
<td>.1140</td>
<td>.1002</td>
<td>.0000</td>
<td>.5000</td>
<td>407</td>
</tr>
<tr>
<td>Beef</td>
<td>.1586</td>
<td>.1190</td>
<td>.0000</td>
<td>1.0000</td>
<td>407</td>
</tr>
<tr>
<td>Ready-to-eat</td>
<td>.0583</td>
<td>.0863</td>
<td>.0000</td>
<td>.4000</td>
<td>407</td>
</tr>
</tbody>
</table>

The shoppers were asked about the preferences of each member of the family over the meats. Because only the shopper was surveyed, there is a potential difference between reported and actual family preferences. However, these survey results should represent the shopper's perception of preferences, which is more important when measuring the power relationship between the shopper and each family member. These
are the preferences the shopper uses when deciding what to buy to satisfy any compromises or agreements (stated or unstated) within the family. Children were broken into three groups by age in years: under 10, 10 to 14, and 15 to 19. For each member, a 1 was recorded to indicate a preference for the meat, and a 0 to indicate a dislike for the meat. If more than one child was included in a category, then preferences represent an average of the children’s preferences. If no children were included in a category, a zero was recorded. Both of these conventions of the survey may cause some degree of measurement error.

Because of differences in response modes, there is a need to adjust these data. For example, consider a respondent who liked only chicken. This individual’s preferences are represented by a 1 for chicken preference, and 0 for all other meats. In this case it seems reasonable that the individual’s preference would lead to a greater frequency of chicken meals. Consider, alternatively, an individual who likes all meats, and, hence, records a 1 for each meat preference. It is not likely that his preferences will induce more consumption of chicken. Yet, without adjusting preferences to account for relative variability preferences, regressions would treat the data as if the individuals had the same tendency to purchase chicken.

To put it simply, it is variability in relative preferences, not the absolute values, that should determine purchasing behavior. To correct for this problem, a share of preference was calculated for each individual for each meat by dividing that individual’s rank for meat $m$ by the sum of that individual’s ranks for all meats. We then weighted each share to constrain each individual’s preferences to have a standard deviation of either 1 or 0. Each individual (with any deviation in preferences) is assigned the same
variability in preferences. It is the size of this variability that determines the magnitude of family power coefficient later. Standardizing the preference variability will allow these power coefficients to be comparable after estimation. Thus estimated social power weights will not be tainted by problems with variability in preferences. In this way each individual’s preferences will have the same variability, and, hence, potential to explain purchasing behavior. The weighting is as follows

\[
\alpha_n^k = \begin{cases} 
\frac{a_n^k}{\left( \sum_{m=1}^M (a_m^k - \bar{a}_k)^2 \right)^{\frac{1}{2}}} & \text{if } \sum_{m=1}^M (a_m^k - \bar{a}_k)^2 > 0 \\
a_n^k & \text{otherwise}
\end{cases}
\]

where \(a_n^k\) is person \(k\)'s calculated share of preference for meat \(n\), and \(\bar{a}_k\) is person \(k\)'s average preference share over all meats. In this way, interpretation of the survey scale will not be a factor in determining significance of an individual's influence. The normalization we have chosen is conceptually similar to those commonly used in market share analysis. In the case of a missing individual, or a zero standard deviation, \(\alpha_n^k\) was set to zero. Table 2 displays summary statistics for each family members' preferences.
Table 2: Summary Statistics for Family Members' Preferences

<table>
<thead>
<tr>
<th>Family Member</th>
<th>Meat</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Husband</td>
<td>Chicken</td>
<td>.5241</td>
<td>.4769</td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>.2162</td>
<td>.3974</td>
</tr>
<tr>
<td></td>
<td>Processed Chicken</td>
<td>.2898</td>
<td>.4291</td>
</tr>
<tr>
<td></td>
<td>Processed Turkey</td>
<td>.1647</td>
<td>.3600</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
<td>.3488</td>
<td>.4545</td>
</tr>
<tr>
<td></td>
<td>Ready-to-Eat</td>
<td>.0583</td>
<td>.2116</td>
</tr>
<tr>
<td>Wife</td>
<td>Chicken</td>
<td>.5418</td>
<td>.4841</td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>.1588</td>
<td>.3547</td>
</tr>
<tr>
<td></td>
<td>Processed Chicken</td>
<td>.2648</td>
<td>.4213</td>
</tr>
<tr>
<td></td>
<td>Processed Turkey</td>
<td>.1114</td>
<td>.3070</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
<td>.2518</td>
<td>.4184</td>
</tr>
<tr>
<td></td>
<td>Ready-to-Eat</td>
<td>.0621</td>
<td>.2245</td>
</tr>
<tr>
<td>Child: 0 to 9</td>
<td>Chicken</td>
<td>.2847</td>
<td>.4415</td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>.0778</td>
<td>.2619</td>
</tr>
<tr>
<td></td>
<td>Processed Chicken</td>
<td>.1859</td>
<td>.3721</td>
</tr>
<tr>
<td></td>
<td>Processed Turkey</td>
<td>.0840</td>
<td>.2697</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
<td>.0644</td>
<td>.2411</td>
</tr>
<tr>
<td></td>
<td>Ready-to-Eat</td>
<td>.0592</td>
<td>.2310</td>
</tr>
<tr>
<td>Child: 10 to 14</td>
<td>Chicken</td>
<td>.2190</td>
<td>.4058</td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>.0935</td>
<td>.2922</td>
</tr>
<tr>
<td></td>
<td>Processed Chicken</td>
<td>.1857</td>
<td>.3814</td>
</tr>
<tr>
<td></td>
<td>Processed Turkey</td>
<td>.0927</td>
<td>.2898</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
<td>.1068</td>
<td>.3043</td>
</tr>
<tr>
<td></td>
<td>Ready-to-Eat</td>
<td>.0689</td>
<td>.2445</td>
</tr>
<tr>
<td>Child: 15 to 19</td>
<td>Chicken</td>
<td>.1462</td>
<td>.3354</td>
</tr>
<tr>
<td></td>
<td>Turkey</td>
<td>.0739</td>
<td>.2506</td>
</tr>
<tr>
<td></td>
<td>Processed Chicken</td>
<td>.1287</td>
<td>.3187</td>
</tr>
<tr>
<td></td>
<td>Processed Turkey</td>
<td>.0429</td>
<td>.1896</td>
</tr>
<tr>
<td></td>
<td>Beef</td>
<td>.0857</td>
<td>.2695</td>
</tr>
<tr>
<td></td>
<td>Ready-to-Eat</td>
<td>.0487</td>
<td>.1998</td>
</tr>
</tbody>
</table>

Preferences for each meat by each family member display a maximum of 1.0955 and a minimum of 0, with all 408 observations included in each calculation. All observations were used to estimate the demand system in (18) and (16). Each respondent was asked to rank their cook's enjoyment of cooking. We set \( \alpha_c = \frac{1}{b} \), where \( b \) is the cook's enjoyment of cooking on a scale of 1 to 5, 5 being interpreted as hating to cook. Income is used as a proxy for \( w \). Respondents were asked to report the
number of hours spent cooking each week. Because respondents were not asked quantitatively how much time was allotted to leisure and other chores, any time not used in cooking is assumed to be leisure. Thus (16) collapses to

\[
(19) \quad I - \sum_{m=1}^{M} P^m x^m = 0.
\]

In (18) times used in cooking meals only appear when summed together. Thus we substitute \( t_c = \sum_{m=1}^{M} t^m \).

In the survey only five members were considered: husband, wife, children age 0--9, children age 10--14, and children age 15--19. If there was more than one child in a certain age group, we allowed the parent to report an average, or, if one was more influential, that child’s preferences. If there was not a child in a category, their responses were recorded as 0, which has the effect of making the utility constant over all bundles of meat for that individual (i.e. the individual is considered indifferent). We did the same for any missing parents. While there were few missing parents, there were many missing observations for children. To control for these missing observations we divided the preference of each child for each meat by the probability of observing a child in that age group conditional on the sex of the shopper.

**Meat Consumption and Prices**

Average prices per pound were obtained for each of the categories from the Israeli Poultry Growers’ Association. While price averages for each category account for much of the deviation in expenditure, there are obvious quality differences within
food types, and differences in family sizes. Respondents were asked to classify their family as having above average, average, or below average income. Of those who responded, 151 respondents said their families' income was above average, 152 had average income, and 98 had below average income. Using data collected on specific chicken parts purchased, we were able to estimate the average price of a chicken meal for each income group. See the appendix for a detailed description of this procedure.

Estimation of Social Power

In most Israeli families, the wife does the shopping (69%). Only 31% of families reported that the husband performed this duty. Accordingly, we estimate two sets of power coefficients: one where husbands shop, and one where wives shop. The survey did not ask which member of the family was responsible for the cooking. Because of the sociological background in Israel, and for simplicity's sake, we assume the wife is primarily responsible for cooking in all households.

Note in (18) that the variable $\gamma$ always appears in conjunction with expenditure. This means that estimation techniques will be fruitless in differentiating between larger wages and a larger $\gamma$. Thus we have set $\gamma$ equal to 1, allowing this variable to be incorporated in the estimates of coefficients on expenditure. In other words, we estimate relative expenditure. In order to find actual expenditure, we would need to know $\gamma$, which is roughly the amount of meat in one individual’s meal.

Productivity is expected to behave differently for each meat. In particular, ready-to-eat food can only be prepared in pre-determined constant amounts of time. We thus assume the marginal productivity of time spent in making ready-to-eat food is 0. For all other meats, we expect that there may be wide differences in productivity among cooks.
To control for this we have allowed skill in cooking to interact with $\xi_m$. This skill was measured as a function of how well the family liked the cooking, $\theta$. The variable $\theta$ is measured on a scale of 1 to 4. A 1 was recorded if the family loved the cooks cooking, and a 4 if they hated it. Thus the equations to be estimated are:

\[
(20) \quad x^m = R + \sum_{k=1}^{K} \left( (1-h)\beta_k + h\beta_k^h \right) \alpha^c_m \left( \frac{Inc - \xi_m - \theta \xi^2_m}{P} \right) t_e + \varepsilon_{mt}
\]

where,

\[
R = v^m + v^m_{cons} \text{Cons} + v^m_{rel} \text{Rel} + v^m_{orth} \text{Orth},
\]

\[
Inc = I_0 + w^{low} I_1 + w^{high} I_2,
\]

\[
P = P^m \left( 1 + w^{low} \frac{P^{low}}{P^{avg}} + w^{high} \frac{P^{low}}{P^{avg}} \right).
\]

\[
(21) \quad \left( I_0 + w^{low} I_1 + w^{high} I_2 \right) T - \sum_{m=1}^{M} P^m \left( 1 + w^{low} \frac{P^{low}}{P^{avg}} + w^{high} \frac{P^{high}}{P^{avg}} \right) x^m = u_t
\]

\[
(22) \quad \sum_{k=1}^{K} \beta_k^i = 1, \quad \text{for } i = w, h
\]

\[
(23) \quad \beta_k^i \geq 0 \quad \text{for } i = h, w, \text{ and } k \neq K
\]

where $h$ is a dummy variable that takes on a value of 1 if the husband did the shopping.
and 0 otherwise, $\beta_i^k$ is the power for individual $k$ when individual $i$ shops, $i=w$ when the wife is shopping, and $i=h$ when the husband is shopping, $w^{low}$ is a dummy variable indicating below average income, $w^{high}$ is a dummy variable indicating above average income, $Cons$ indicates that individuals are religiously conservative, $Rel$ indicates they are religious, $Orth$ indicates they are orthodox, $P^{low}$ is the estimated price of a low income chicken meal, $P^{avg}$ is the price of an average income chicken meal, $P^{high}$ is the price of a high income chicken meal, $\epsilon_{mt}$ is a normal disturbance term for meat $m$ and family $t$, and $u_t$ is a normal disturbance term for family $t$. Both disturbance terms arise from possible measurement error in $x^m$. The respondents were asked about their average frequency of meat consumption and could have poor memories. All disturbance terms may be correlated. We set $\bar{T}$ equal to 40, the average length of a work week. The last two equations are restrictions that allow all power coefficients to be estimated. They basically normalize power to a unit sum regardless of who is shopping, and that all but one person have positive power. These equations are not tractable for estimation if all are restricted to have positive power. We have in all cases allowed the group of children ages 15 to 19 year olds to have negative power. This will be discussed further in the section on results. The coefficients requiring estimation are:

$$\beta_1^w, \ldots, \beta_K^w, \beta_1^h, \ldots, \beta_K^h, \xi_1^1, \ldots, \xi_1^M, \xi_2^1, \ldots, \xi_2^M, v^1, \ldots, v^M, v_i^1, \ldots, v_i^M, v_{cons}^1, \ldots, v_{cons}^M, v_{rel}^1, \ldots, v_{rel}^M, v_{orth}^1, \ldots, v_{orth}^M, I_0, I_1, I_2$$

In all there are 7 equations and 49 parameters.

Our estimation is complicated by the fact that all of the dependent variables are censored from the left, because only values above 0 are observed. Heckman (1979)
derived a method for obtaining consistent estimates of a single dependent variable censored on one side, by using an inverse Mills ratio. Since that time others have applied his method to the multivariate censored case. Here we use the estimation technique outlined in Ham (1982) for the case of the multiple censored regression. Most families (more than 240) had at least one meat for which they reported a zero consumption. Thus we calculate the Mills ratio for censoring from the left.

To estimate the inverse Mills ratio, we first must estimate the probit model using (20), but replace $x^m$ with a variable that takes on the value one if the true value of $x^m$ is observed and 0 if the value is censored. The inverse Mills ratio is calculated for each observation as $\rho = \frac{\Phi(Q)}{\phi(Q)}$ where $\Phi$ is the standard normal cumulative density function, $\phi$ is the standard normal probability density function, and $Q$ is the estimated value of the right hand side of the equations. An Inverse Mills ratio could not be computed for the chicken equation because the variables exactly predict unobserved variables. There were only seven instances of a zero chicken observation so it is not likely that much bias is introduced by omitting the Mills ratio for chicken. Thus, 5 series of inverse Mills ratios (one for each meat aside from chicken) was obtained. The summary statistics for the Mills ratios are shown in table 3. The Mills ratio gives a measure of bias from excluding the restriction excluding negative consumption. Mills ratios in this context are often interpreted as the shadow-price of the constraint. In this case the Mills ratio measures the marginal family utility for relaxing the restriction on negative consumption. These ratios are added to the regression as additive regressors.

---

1 See for example Grossman and Joyce (1990).
Table 3: Summary of Inverse Mills Ratios

<table>
<thead>
<tr>
<th>Meat</th>
<th>Average Mills Ratio</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey</td>
<td>1.479×10^{-8}</td>
<td>.747</td>
</tr>
<tr>
<td>Beef</td>
<td>8.677×10^{-9}</td>
<td>.691</td>
</tr>
<tr>
<td>Processed Chicken</td>
<td>4.485×10^{-9}</td>
<td>.642</td>
</tr>
<tr>
<td>Processed Turkey</td>
<td>7.423×10^{-9}</td>
<td>.759</td>
</tr>
<tr>
<td>Ready-to-Eat</td>
<td>1.391×10^{-8}</td>
<td>.766</td>
</tr>
</tbody>
</table>

Estimation Results

We estimated the system using non-linear three stage least squares. The results of estimation are presented in Table 4. The use of Mills ratios introduces heteroskedasticity. Estimates were corrected using a White-heteroskedasticity consistent matrix. The regressions report R-squares of .06, .62, .57, .62, .68 and .71 for chicken, turkey, beef, processed chicken, processed turkey, and ready-to-eat, respectively. The low R-square for chicken may be due to the inability to include the inverse Mills-ratio as a regressor. It may also be due to the staple status that chicken has among this population. Variation in chicken consumption may be due less to the factors we have considered than to other social factors. Considering that all estimation was conducted using cross section survey data, these results are quite good.

Expenditure

The coefficient $I_1$ is significantly negative. This makes sense as it suggests that families categorized as low income by our survey spend less money than do those classified as average income families. The coefficient $I_2$ is significantly positive suggesting those classified as high income families spend more than do those classified as average income families. Assuming individuals consume an average of one twentieth of a kilogram of...
meat each meal (about 1/8 lb.) then low, average and high income families spend an average of 17.96, 20.74, and 21.54 shekels per meal on meat. These estimates suggest that low average and high income individuals spend about 126, 145 and 150 shekels per week on meat (about $38, $44, and $46).

The Effects of Religion On Consumption

It appears that being religious or orthodox does have significant impacts on what types of meats are consumed. In Judaism there are different specifications and authorizations of kosher food. If a small orthodox court needs its own kosher authorization its members will find it more difficult to find their foods in the regular supermarkets. The kosher specifications of religious courts are more easily addressed in row meats as the slaughterer may be a member of this community. With ready to eat foods that are made commercially, the central religious supervising authority may not be strict enough by local standards, and thus ultra orthodox will usually avoid consuming such foods. Using a .1 significance level, being religious causes more consumption of chicken and turkey, and less consumption of ready to eat food.

The Sholhan Aroch (the everyday rules of religious observant behavior) says that the Friday night ceremonial dinner should include food that is not eaten usually during the weekdays and specifies beef as the most appropriate meat. A Jew that wants to keep this rule without giving it his personal interpretation will eat chicken and turkey on weekdays and beef on the weekends regardless of preferences. Since there are 5 weekdays and only 2 in the Sabbath, we may expect to find higher consumption rates of chicken and turkey among religious and orthodox Jews than in the secular and
conservative segments. However, different religious courts may have different traditions about the specific meat that is the most appropriate to be eaten in Friday dinner. For example, Jews that came from East Europe, where chicken was rare may consume it on Friday nights and eat turkey and beef on weekdays. In fact, we find that being orthodox causes an individual to consume more chicken, turkey, and processed turkey. Orthodox and religious individuals differ in their consumption of processed turkey and ready-to-eat foods, which illustrates the heterogeneous emphasis of the varying beliefs within Israel.

**Productivity and the Ability to Cook**

The variables $\xi^m + \xi^m \theta$ represent the amount of one meal that can be produced in one hour. Turkey and processed turkey appear to take the least amount of time to prepare, while beef appears to take the greatest amount of time to prepare. Most beef in Israel is barbequed, which can be very costly in terms of time.

It appears from Table 4 that ability to cook has the greatest effect when cooking turkey and processed turkey (significant at the .1 level). More interesting is the relationship suggested between turkey and processed turkey. For better cooks, turkey takes less time to prepare than processed turkey, while for worse cooks processed turkey takes less time. The ability to cook does not significantly affect time in preparation for all other meats.
Table 4. Results of Estimation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Interpretation</th>
<th>Estimate</th>
<th>t-value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_{1w}$</td>
<td>Husband’s power when wife shopping.</td>
<td>.1962</td>
<td>3.8426</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1w}$</td>
<td>Wife’s power when wife shopping.</td>
<td>.5019</td>
<td>10.4194</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1y}$</td>
<td>0 – 9 year old’s power when wife shopping</td>
<td>.1694</td>
<td>6.9103</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1y}$</td>
<td>10 – 14 year old’s power when wife shopping</td>
<td>.0673</td>
<td>3.1044</td>
<td>.002</td>
</tr>
<tr>
<td>$\beta_{1y}$</td>
<td>15 – 19 year old’s power when wife shopping</td>
<td>.0652</td>
<td>9.1514</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1w}$</td>
<td>Husband’s power when husband shopping.</td>
<td>.4013</td>
<td>5.9663</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1w}$</td>
<td>Wife’s power when husband shopping.</td>
<td>.3549</td>
<td>9.1359</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1y}$</td>
<td>0 – 9 year old’s power when husband shopping</td>
<td>.3339</td>
<td>4.9485</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1y}$</td>
<td>10 – 14 year old’s power when husband shopping</td>
<td>.3655</td>
<td>4.0503</td>
<td>.000</td>
</tr>
<tr>
<td>$\beta_{1y}$</td>
<td>15 – 19 year old’s power when husband shopping</td>
<td>-.4556</td>
<td>-8.229</td>
<td>.411</td>
</tr>
<tr>
<td>$I_0$</td>
<td>Average expenditure on meats per person per hour worked divided by amount consumed each meal for middle income group.</td>
<td>.3563</td>
<td>41.6874</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: The table continues with similar entries for each parameter, including effects on consumption of chicken, turkey, and ready-to-eat (RTE) products, as well as coefficients on the inverse Mills ratio for various equations.
Power Distribution

From the estimates above it is clear that different preferences are represented when the wife shops than when the husband shops. This is consistent with Zusman's model in that family members' threat points (strategies under non-cooperation) will have heterogeneous impacts on the members of the family. In other words, a 10 to 14-year old (henceforth "upper-bound" year old) may be able to have a larger impact trying to appeal to their father than their mother, as above (testing the hypothesis of no difference is rejected at the .05 level). An alternative explanation follows Palan and Wilkes (1997) who argued that children gain more influence when they mimic their parents’ behavior. If young children mimic their parents’ behavior while teenagers resist, then the young children gain more affection while the teenagers will have only minor influence.

We next conduct a series of tests with null hypothesis $\beta_k^w = \beta_k^h$ against the alternative $\beta_k^w \neq \beta_k^h$. These tests are conducted using a Wald chi-squared statistic. This test rejects the hypothesis for the mother (p-value .000), the father (.002), the 9 year olds (.001), and the 14 year olds (.049) but not for the 19 year olds (.260).

In both cases, the shopper gives their own preferences a heavier weight than their spouse or children. The estimates suggest the parents give less power to the older children, than to the younger. The main difference between fathers and mothers is the magnitude of weight given to self and spouse. Mothers give much higher weight to themselves and much less weight comparatively to their spouse than do fathers. The heavy emphasis on self in shopping leaves little room for children’s influence. One possible explanation for this difference is a greater attention to nutrition by mothers. Evidence from Thomas (1991) suggests that mothers tend to care more for the nutrition
of their children than do fathers. It may also be a result of greater attention to ease of cooking when a mother shops.

In another survey done in Israel (Haaretz 16/5/00), 60.6% of the food purchasing decisions are done by women without consulting with other family members, 34.9% reported that food purchases are a joint family decision, and only 5.1% are done by the male. In contrast, when purchasing automobiles, 25.7% of the decisions were made solely by the man, 21% by the woman, and the other 63.3% were joint family decisions. Similar patterns were reported with regard to the purchase of household appliances such as refrigerators, air conditioners and washing machines. These results support our findings that when the woman makes purchases, she gives more power to her needs and preferences; but, when the male buys, in many cases, he acts as a “messenger” that performs joint decisions and, thus reflects family needs more.

Another possible explanation for the higher weight women put on their own needs relative to other members’ is their time constraint. Evidence suggests that the help working women get does not compensate for the additional work load at home. This may lead to a change in consumption patterns leading working women to prefer easy-to-cook foods. Empirical work shows mixed results. Strober and Weinberg (1980), Weinberg and Winer (1983), and Kim (1989) found that working women did not have different buying patterns from nonworking women. In contrast, Nicklos and Fox (1983) and Ballente and Foster (1984) found significant differences in the amount of time spent in the kitchen for preparing meals and an increase in the expenditure on food out of the family. These researchers also found, however, that income and life style variables influenced the decision to purchase meals outside the home. This may suggest that if some meats are
perceived as easier to cook than others, women may bias purchasing decisions toward these meats. For example, women reported that chicken is the easiest meat to prepare. In addition, it is the meat preferred most often by women. Thus, both taste preferences and time saving increases the women’s (those who cook) preference weight.

Next we perform a series of tests to see if the mother is more powerful than other family members under both regimes. All tests have a null hypothesis that the mother is less powerful. When the mother shops, this hypothesis is rejected for the father (.065), the 9 year olds (.004), the 14 year olds (.10), but not for the 19 year olds (.163).

When the father shops the mother is more powerful than the 9 year olds (.000), and the 19 year olds (.000). A reverse test rejects the hypothesis that the mother is weaker than the father (.005), and the 14 year olds (.005).

We now perform similar tests comparing the power of the father to each family member. When the mother shops the father is more powerful than the 9 year olds (.017), and the 19 year olds (.000). A test comparing the father to the 14 year olds is not rejected (.140). When the father shops the father is more powerful than the 9 year olds (.001), and the 14 year olds (.015). A test comparing the father to the 19 year olds is not rejected (.205).

**Conclusion**

In this paper we use cooperative game theory and Becker's theory of family production to evaluate family power distributions in consumption of meat. We find that parents tend to have more power when they shop than when their spouse shops. Husbands appear to give more power to younger children than their wives. Parents’
decisions are affected in different ways by their children’s influences: the mother largely ignores children’s preferences, while the father distributes power more evenly.

The possibility that family consumption decisions are the result of bargaining within the family has a profound effect on traditional demand theory, introducing sociological influences. Demand are not determined solely by income and price, but also by factors affecting group purchases such as who is shopping. Outside social factors determining bargaining outcomes are also important in describing purchasing variability.

Some weaknesses in our data suggest that these results can be improved upon. A future survey in the U.S. will include data on who is cooking. Experience will also allow the design of meat categories that are easier to price and allow specification of complete systems. Utility is possibly modeled incorrectly in the form we have chosen. Better utility measures may lead to more accurate modeling of individual’s utility of food and cooking. Data on income may also be gathered on a finer scale.

Despite the data problems, however, the results are significant and reasonable. The results suggest that some bargaining mechanism is driving consumption decisions. Given the large proportion of consumption decisions made in the family context, further effort should be made to combine family bargaining theory and demand analysis. More research must be done to determine what factors determine relative power of family members (such as relative incomes, age, religion, etc.). Marketing firms often take social factors into account when designing advertisements. Similarly, economic models should consider social factors when analyzing purchasing behavior.
Appendix

To estimate the relative prices of meals for various income levels and meat, we used OLS to regress the frequency of chicken meals on the relative frequency reported of each type of chicken package for each income group, i.e.

\[
\text{chicken} = \psi_1^I \text{frozcncut} + \psi_2^I \text{freshecut} + \psi_3^I \text{frozenwhole} + \psi_4^I \text{freshwhole},
\]

where the \( I \) superscript represents income group, \( \text{frozcncut} \) is the relative frequency of meals involving frozen cut chicken meat, \( \text{freshecut} \) is the relative frequency of meals involving fresh cut chicken meat, \( \text{frozenwhole} \) is the relative frequency of meals involving frozen whole chicken, and \( \text{freshwhole} \) is the relative frequency of meals involving fresh whole chicken. A separate regression was run for each of the three income groups.

These weights were used to calculate the price of an average meal for each group \( (P^I = \psi_1^I P^\text{frozcncut} + \psi_2^I P^\text{freshecut} + \psi_3^I P^\text{frozenwhole} + \psi_4^I P^\text{freshwhole}) \). We then multiplied this price by the average number of family members in each income group. We found that the high income group spent 2.64\% more per chicken meal than did average income families. Low income families spent 10.86\% less than average income families. We assumed the percentage difference in expenditure would be identical for all meats. All prices were normalized, dividing each price by the price of chicken for an average income family.
References


Haaretz “Choosing together the refrigerator but not the food,” *Hani Barabash* 16/5/00.


