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Spousal Bargaining Power and Consumption of Married Couples in the US: Evidence from Scanner Data*

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Abstract

This paper studies how spousal bargaining power affects consumption patterns of married households in the US, using a detailed barcode-level dataset. We use two distribution factors as proxies for spousal bargaining power: (1) spouses' relative education and (2) spouses' relative potential wage, which is our preferred distribution factor. As an arguably exogenous measure of bargaining power, our relative potential wage is constructed as a Bartik style measure of female-to-male wage ratio, exploiting county-level variations in heterogeneous exposure to different industries and statewide wage growth. We find that the expenditure shares on women's beauty goods increase and the expenditure shares on alcohol decrease significantly both when relative education of wife increases and when relative potential wages of wives increase. These results are consistent with household bargaining explanations. For couples with children, improved women's household bargaining position is associated with higher budget share on books, stationary, and school supplies, which are potentially related to investment in children. For singles, we do not find statistically meaningful effects of relative potential wage on any of their consumption outcomes, which strengthens the interpretation that the relative wage only affects couples' consumption decisions.

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1 Introduction

There is substantial evidence from the developing country settings that bargaining power within household affects household decision-making in consumption. For example, unearned income in the hands of wives results in healthier food consumption (Thomas, 1990; Attanasio and Lechene, 2014; Armand et al., 2020) and improved children's nutritional outcomes (Duflo, 2003). Other factors, such as marriage market conditions (Ahn, 2020) and women's age (Calvi, 2020), are also shown to affect whether households allocate more expenditure to female-exclusive goods. However, there is a lack of evidence on whether the bargaining power between spouses affects household consumption in the developed economies, where gender inequality still exists but is less pronounced than in the developing countries.

In this paper, we study the impacts of spouse bargaining power on household consumption patterns of married couples in the United States, using a detailed, barcode-level expenditure data from 2004 to 2017. We use two proxies for spouse bargaining position in the household. The first proxy is the relative education level between two spouses, which is a commonly used distribution factor[1] in the intrahousehold bargaining literature. However, using spouse relative education as a distribution factor may have endogeneity issues, because couples do not match randomly. Couples with similar education level may have different consumption preferences compared to those who marry someone with different education level. To alleviate this issue, we construct the second proxy of spouse bargaining power – the relative potential wages of women to men, which exploits plausibly exogenous labor demand shocks for industries that are largely segregated by gender. Our measure of relative *potential* wage is, to the best of our knowledge, a novel distribution factor that has not been used in the literature, and this is our preferred distribution factor in our analyses.

Previous literature on family economics shows that relative earnings are important determinants of bargaining power within households.[2] Most of existing studies use *household-level* relative observed earnings as a measure of bargaining power within households. Although household-level relative earnings are likely to reflect bargaining powers, using them in the demand equations posits methodological

[1] "Distribution factor" refers to any variable that affects the decision process of households but does not influence preferences or budget constraints.

[2] Conditional on total family income, the source of income (or relative income) should not matter in determining household allocations if households behave as if it is a unitary entity. However, this income pooling hypothesis has been numerously rejected, supporting the collective approaches where husbands and wives may have different preferences and bargaining power affects final allocations.

concerns because relative earnings may be correlated with unobserved preference heterogeneity. For instance, relative preferences for clothing may be correlated with relative tastes for working. If this is the case, we would see a positive correlation between relative earnings and relative demands for clothing. However, this is a spurious correlation and not a bargaining power impact.

To overcome these potential endogeneity concerns associated with using household-level relative wages, we construct a Bartik-style *market-level* relative potential wages of women. This measure exploits the fact that men and women have been more dominant in different industries (e.g., construction for men and service industries for women). We create sex-specific local wages based on the industrial composition of the county and state-level wage growth. This allows us to separate the effects of relative wages and underlying worker characteristics in the county, which could be correlated with consumption patterns. In contrast to studies that focus on shocks to specific industries (Kearney and Wilson, 2018; Autor et al., 2019), our Bartik-style approach utilizes wage variation across all industries and across all states, which is similar to the approaches in Aizer (2010) and Shenhav (2021). Our paper adds to the growing evidence that gender-relative labor market shocks affect family outcomes, such as domestic violence (Aizer, 2010; Erten and Keskin, 2021), marriage or fertility (Autor et al., 2019; Kearney and Wilson, 2018; Shenhav, 2021), and spouse quality (Shenhav, 2021). In contrast to previous studies focusing on relatively high-stake rare events, we focus on daily decisions which have implications on a broader set of populations.

We use Nielsen Consumer Panel Data from 2004 to 2017 to measure consumption patterns of households in the US. Nielsen dataset have several benefits relative to typical consumer expenditure surveys. Household expenditure surveys generally do not have information on where the purchase was made and are aggregated to rather large consumption categories (e.g., beef) without details of the products. In contrast, Nielsen dataset have the UPC-level information as well as the detailed information on the frequency of purchases and the stores where the purchases were made. This helps us understand the impacts on consumption patterns in detail and mechanisms at play. Moreover, we can identify various gender-exclusive goods using detailed product information.

Our current results find that both higher wife's education relative to husband's and higher female-to-male wage ratio affect household budget shares of married couples in a way that is more favorable to wives. We first present results using the difference between wife's and husband's years of education, fixing husband's education level. We find that higher wife's education relative to husband's is

associated with a larger expenditure share on health and beauty goods, a smaller expenditure share on alcohol and tobacco, and a larger budget share on books, stationary, and school supplies. These effects are all statistically significant at the 1% level. Because our descriptive analyses show that single women allocate significantly more budget on beauty items and single men allocate significantly more budget on alcohol, we interpret these results as a higher relative female education shifting household budget share more favorable to wives.

Using relative potential wages also results in similar findings that are consistent with the bargaining power story. We show that a rise in gender wage ratio significantly increases the budget share on beauty and significantly decreases the budget share on alcohol. These results are statistically significant at 5% level, after controlling for a rich set of individual-level controls and fixed effects. For food consumption, although the effects are not statistically significant with the current categorization of food items, we find that the higher gender wage ratio seem to increase food budget on frozen food.[3] We also find results that are potentially related to child investment. We find that households allocate more on books, stationary, and school supplies when female-to-male wage ratio rises. When dividing our sample into couples with children and couples without children, we find that the statistically significant positive effect on books, stationary, and school supplies consumption is only found for couples with children.

We investigate potential mechanisms which may explain the results other than the bargaining power channel. One potential channel that explains the results is the total income effect because relative earnings gap may affect total household earnings. We rule out this channel by showing that the gender wage ratio does not affect household income or total household expenditure. Another potential channel is changes in labor supply of husbands and wives. This channel can be particularly important to understand the impacts on food consumption. We plan to investigate this channel more in depth in the future. We also show that both the relative potential gender wage and the opposite gender potential wage do not have statistically meaningful effects on any of the consumption outcomes for single individuals living alone. This strengthens the interpretation that the relative wage only matters for the consumption of couples.

To further understand the impacts of relative wages on household bargaining, we estimate how relative wage ratios affect a sharing rule, how married couples split household resources, using a

[3] We plan to investigate the effects of gender wage ratio on food consumption using more detailed food categories.

structural model. Specifically, we use a collective household model and rely on identification results from Chiappori et al. (2002) which allow us to recover the partial of the sharing rule with respect to relative female wages. We find that a standard deviation increase in relative female wages leads to an increase of 63.7 dollars in wives' shares. The size of the impact should be understood in the context of expenditure; this change is computed out of average total annual household expenditure of $4,025 on Nielsen-tracked items.[4] As such, the seemingly small amount corresponds to 1.6% of total Nielsen expenditures, which is a significant change. This estimate shows that changes in labor market conditions favorable to women influence overall household allocations so that women control more resources within households.

2 Conceptual Framework

Over the past 30 years, it has been widely shown that households do not behave as a unitary entity for making economic decisions such as labor supply or consumption. The unitary household model assumes that households have a single representative utility function under a common budget constraint, which is obtained by pooling the incomes of every household member. The income pooling hypothesis from the unitary assumption has been rejected from numerous empirical studies (Browning et al., 2014).

The collective model approach makes a more realistic assumption that multiple agents within households may have different preferences. It assumes that household bargaining leads to Pareto-efficient allocations—meaning that no other feasible choice would have been preferred by every household member. This cooperative model assumption is likely to hold for married couples who know each other's preferences well and interact on a regular basis.[5] We introduce the baseline collective model here and explain how this model relates to our empirical setting.

Suppose that there are two members of the household, h (husband) and w (wife). The household utility can be represented as follows:

$$u^H(\mathbf{Q}, \mathbf{q}, \mu(\mathbf{P}, \mathbf{p}, x, \mathbf{z})) = \max_{\mathbf{q_h}, \mathbf{q_w}} \{u^h(\mathbf{Q}, \mathbf{q^h}) + \mu(\mathbf{P}, \mathbf{p}, x, \mathbf{z}) u^w(\mathbf{Q}, \mathbf{q^w})\}$$

[4] Nielsen is focused mostly on frequently purchased, grocery-related items.

[5] There is another class of household decision models which is based on non-cooperative assumptions. Refer to Lundberg and Pollak (1993) for "separate spheres" models. For these models, allocations within marriage are characterized by a non-cooperative Nash equilibrium.

subject to $\mathbf{q^h} + \mathbf{q^w} = \mathbf{q}$. $\mathbf{Q}$ and $\mathbf{q}$ indicate the vectors of public goods and private goods. $\mathbf{q^h}$ and $\mathbf{q^w}$ are private goods for husbands and wives, respectively. x is the total household expenditure. $\mathbf{z}$ is a vector of distribution factors. Distribution factors are variables which affect decision process but do not affect preferences or budget constraints. $\mu(\mathbf{P}, \mathbf{p}, x, \mathbf{z})$ is Pareto weight and can be interpreted as relative *power* of the wife. This Pareto weight determines the optimal allocation among the outcomes characterized by the Pareto frontier. The household budget constraint is given as follows:

$$\mathbf{P'Q} + \mathbf{p'}(\mathbf{q^h} + \mathbf{q^w}) \leq x$$

Empirically, we do not observe Pareto weight μ. However, we can observe distribution factors which affect the outcomes only through the impacts on the Pareto weight. Such examples include relative income, relative age, sex ratios, divorce laws, and gender of the benefit's recipient.[6] If there is a change in a distribution factor, which is favorable to women (e.g., women become the recipient of benefits), Pareto weight increases and this leads to household allocation choices which favor women.

To understand the impacts of spousal bargaining power on consumption patterns of households, we consider two distribution factors which may affect consumption choices of households, as mentioned in the introduction. The first distribution factor is relative education, which has been extensively used as a proxy for bargaining power in the literature (e.g., Quisumbing and Maluccio (2003); Basu and Ray (2011); Schaner (2017)). If wife is more educated than husband, she may have more say in household decision-making process, including consumption. Previous literature suggests that higher relative education of wives matters for household decision making; for example, Calvo et al. (2021) document that women who are at least as educated as their husbands receive a larger share of the household private consumption, using German socioeconomic panel. However, as Lewbel and Pendakur (2008) point out, one caveat associated with using relative education as a distribution factor is that it is often difficult to distinguish the pure (demographic) education impact from a relative education (distribution factor) impact.

The second distribution factor is gender-specific labor market conditions. Better labor market opportunities for women relative to men are likely to increase women's ability to extract more resources within the household. The previous literature has shown that relative incomes, wages, or earnings

[6] For detailed explanations on possible distribution factors, refer to Browning et al. (2014).

are important distribution factors which affect household consumption decisions (e.g., Browning et al. (1994), Thomas (1990)). However, if these measures are calculated at the household level, we face potential endogeneity challenges—relative income may be correlated with unobserved preference differences. To overcome this potential endogeneity issues, we construct a Bartik-style measure of female-to-male wage ratio at the county level which captures potential labor market opportunities for women and men, which we describe in Section 6. In previous literature, Aizer (2010) uses a similarly constructed Bartik female-to-male potential wage ratio in the US setting and shows that as female relative potential wage goes up, domestic violence goes down, which can be explained with women's increased bargaining power. However, the effects of gender-relative potential wage on household consumption in the US setting have not been examined in the literature.

3 Data

3.1 Consumption

For household consumption outcomes, we use the Nielsen Consumer Panel Data that spans from 2004 to 2017, which is made available by the Kilts Center of Marketing at the University of Chicago Booth School of Business. There are 40,000 - 65,000 households participating in the consumer panel each year. The sample is balanced on demographic characteristics to reflect the universe of household in the United States.

This dataset is suitable for our analysis due to the detailed nature of recorded consumption and large sample size. This data contains barcode-level information about the prices and quantities of purchased products that are recorded by the participating households after each shopping trip using in-house scanners. Because product information, price, and quantity of most products are accurately recorded by the in-house scanners, Nielsen dataset has more granular information than the conventional consumer survey datasets in the US (e.g. CEX and PSID) that record household consumption based on a retrospective memory.

Nielsen dataset records all purchases of barcode level products in 10 NielsenIQ food and non-food departments, which are (1) Health and Beauty Aids, (2) Dry Grocery, (3) Frozen Food, (4) Dairy, (5) Deli, (6) Packaged Meat, (7) Fresh Produce[7], (8) Nonfood Grocery, (9) Alcohol, and (10) General

[7]Note that the coverage of "Fresh Produce" is limited because it is only recorded for the items with barcodes. Other

Merchandise. Appendix Table A1 gives further description on what items are included in each of these departments. As long as purchased products are within these department categories, the purchases from all retail outlets (including department stores, grocery stores, convenience stores, and online stores) have to be recorded by the household. Products that are outside these department categories are not recorded in the scanner.[8]

In addition to departments, the purchases are categorized into approximately 100 product groups and approximately 1,000 product modules. In addition to these categories, UPC is recorded for all the purchases, which enables us to figure out exactly what was bought by each households. However, because the barcode-level consumption is too granular for us to investigate, we use aggregate goods, such as departments and clusters of product groups and product modules, for our analyses. Because there are some additions and deletions of product modules over the years, we only keep purchases in the product modules that exist for all years in the data.

Nielsen Consumer Panel Data contains demographic information for *both* wives and husbands for married-couple households. Age, education, hours employed[9], and occupation[10] are recorded for both household heads and the spouses. The availability of these information at the individual level allows us to control for spouse-level characteristics in our analyses. Other demographic characteristics, such as race, family size, number of children, place of residence, and household income[11], are reported at the household level.

3.2 Industry Share and Wage

For constructing a Bartik-style measure of potential relative wages, we use two data sources, (i) US 5% population census (2000), which is used to construct industry shares, and (ii) Quarterly Census of Employment and Wages (QCEW) 2004-2017, which is used to construct wages.[12] QCEW reports quarterly employment and wages reported by employers, covering more than 95% of US jobs. The data is available by industry at the county levels. We use annual version of QCEW data for constructing

products that does not have barcodes, such as random weighted fruit, vegetables, and in-store baked-goods are not recorded by all Nielsen households.

[8]Hence, it should be noted that this dataset does not capture full household consumption. This data represents household consumption on frequently purchased, grocery-related items that are brought to home.

[9]Work hours, conditional on working, are reported in three broad categories: (1) Under 30 hours, (2) 30-34 hours, and (3) 35+ hours.

[10]There are 12 categories for occupation variable that is recorded for household heads and spouses.

[11]Household incomes are reported as bins with 20 categories and with a two-yer lag.

[12]We follow 2-digit NAICS industry classifications.

annual wage levels. Specifically, we obtain γ_{grecj}, the proportion of female (male) workers of race r and education e in industry j in county c from the 2000 Census and w_{-cyj}, statewide annual wages in industry j calculated from the counties except for the focal county c in year y, from the QCEW.

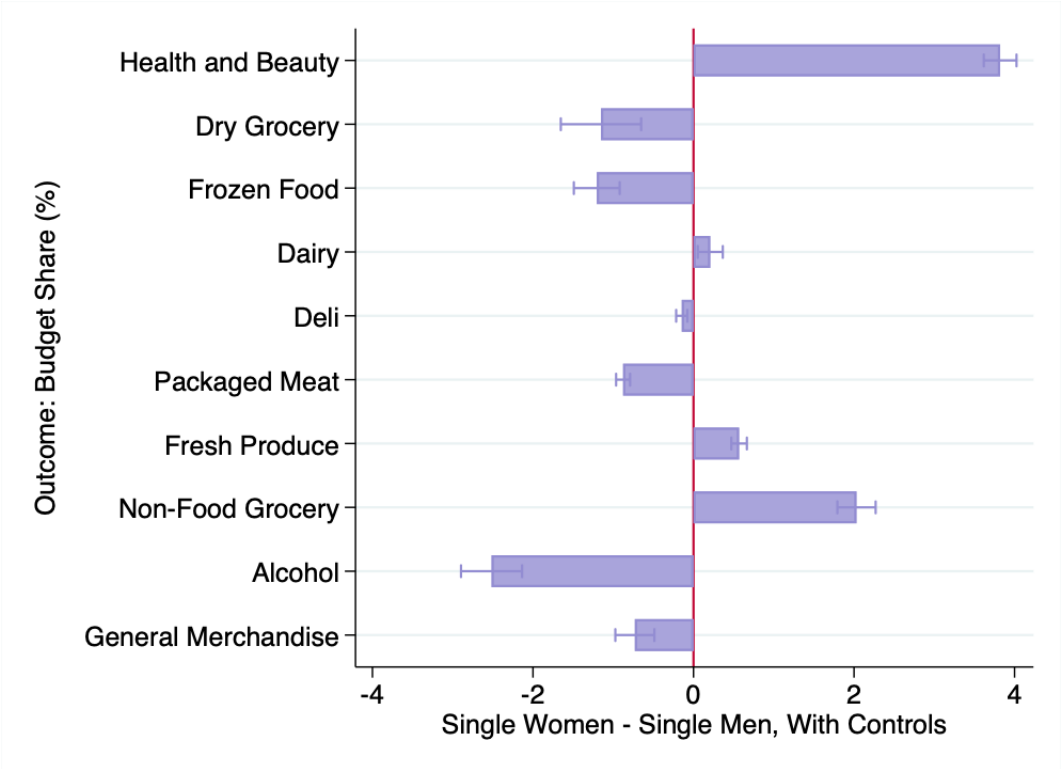
4 Descriptive Statistics

4.1 Gender Differences in Consumption: Singles Living Alone

In order to understand consumption patterns of married couples, it is crucial for us to examine whether there are gender differences in consumption preferences. Because Nielsen consumer data only records consumption at the household-level, not at the individual-level, it is challenging to measure the individual consumption of each spouse. For example, we may observe that the household purchased some apples, but we do not observe who bought and consumed them. For gender-assignable goods, we can still infer preferences from observing household level expenditures (Dunbar et al., 2013; Ahn, 2020; Calvi, 2020). However, given that Nielsen mainly records grocery-related items, we need to find another way to understand each gender's preferences.

To understand differential preferences of men and women, we document consumption patterns of single men and single women who are living alone. The purpose of these exercises is to understand if certain aggregate goods are preferred largely by a particular gender. Using singles sample, we regress expenditure share on each aggregate good on a female indicator, while controlling for various individual-level characteristics including age, years of education, unemployment status, household income, races, as well as year and county fixed effects. We show the results in Figure 1. We find that women tend to spend more on health and beauty, dairy, fresh produce, and non-food grocery, even after controlling for individual observable characteristics and various fixed effects. On the other hand, we find that men have a tendency to spend more on dry food, frozen food, packaged meat, alcohol and general merchandise.

Figure 1: Consumption Patterns by Single Women vs Single Men Living Alone, by Department



Note: Consumer Panel 2004-2017. Sample only includes singles living alone who are between age 25-64. This figure shows the result from regression of budget share for corresponding aggregate good (y-axis) on female indicator and various controls. The bar indicates the regression coefficient on the female indicator. Control variables included in the regressions are: age, years of education, unemployment status, household income, dummies for black and hispanic, year fixed effects, county fixed effects. Household weights are applied. Standard errors are clustered at the state level.

Raw mean budget shares for each gender are presented in Figure A1, which supports that the largest gender differences in budget shares are from health and beauty aids and alcohol. Although raw mean budget shares show some degree of gender differences in all of the aggregate goods, the largest gender gaps relative to the base mean budget shares are shown in health and beauty aids and alcohol categories. For example, Figure A1 shows that single men, on average, allocate twice larger budget shares on alcohol than single women do. In order to further explore if there exist gender differences among finer categories of alcohol, we divide the alcohol consumption into beer, liquor, and wine, using the product group categorization provided by Nielsen. Figure A3 shows the gender differences in detailed alcohol categories: This shows that the gender differences is largest in the beer consumption, whereas there is no statistically significant gender difference in the wine consumption, after controlling for the individual characteristics and year and county fixed effects.

In summary, although it is difficult to identify a perfect women-exclusive good or men-exclusive good on which the opposite gender spends zero amount among the aggregate goods at the department level, health and beauty for women and alcohol for men appear to be two categories whose consumption is more concentrated on a single gender. Among alcohol categories, beer appears to be an aggregate good that is particularly preferred by men more than by women. This pattern of consumption is consistent with the findings in the previous literature where increases in wife's power are associated with decreases in alcohol expenditures (Phipps and Burton, 1998; Hoddinott and Haddad, 1995; Attanasio and Lechene, 2014; Ward-Batts, 2008) and increases in spending on cosmetic goods (Ahn, 2020). For food consumption, women appear to have a stronger preference on healthier diets, spending more on fresh produce and dairy and less on frozen food and packaged meat.

4.2 Married Couple Sample

In this section, we describe the sample of married couples that we use in our main analyses. Because we study the effects of gender-relative labor market condition on consumption of married couples, we limit our sample to married couples where both husbands and wives are working ages, which we define to be between age 25-64. Table 1 shows the summary statistics of annual total expenditure of married couples in our sample. As shown in the first row of the table, untrimmed total expenditure has an outlier problem: Minimum annual total expenditure is shown to be $1.7 and the maximum value is $34,684.4. To alleviate this issue, we drop the couples with annual total expenditure value below the 1st percentile and above the 99th percentile from our sample. Second row of Table 1 shows the summary statistics of trimmed sample based on total expenditure. The mean annual expenditure of Nielsen-tracked items is $4,175.8 and the median is $3,876.4 for our married couple sample.

Table 1: Statistics on Total Annual Expenditure, Married Couples

	# of Obs	Mean	Min	p1	p25	p50	p75	p99	Max
Toal Expenditure (Untrimmed)	340738	4223.2	1.7	949.8	2712.3	3876.4	5326.3	10711.2	34684.4
Toal Expenditure (Trimmed)	333924	4175.8	949.8	1195.5	2736.0	3876.4	5289.5	9615.9	10711.2

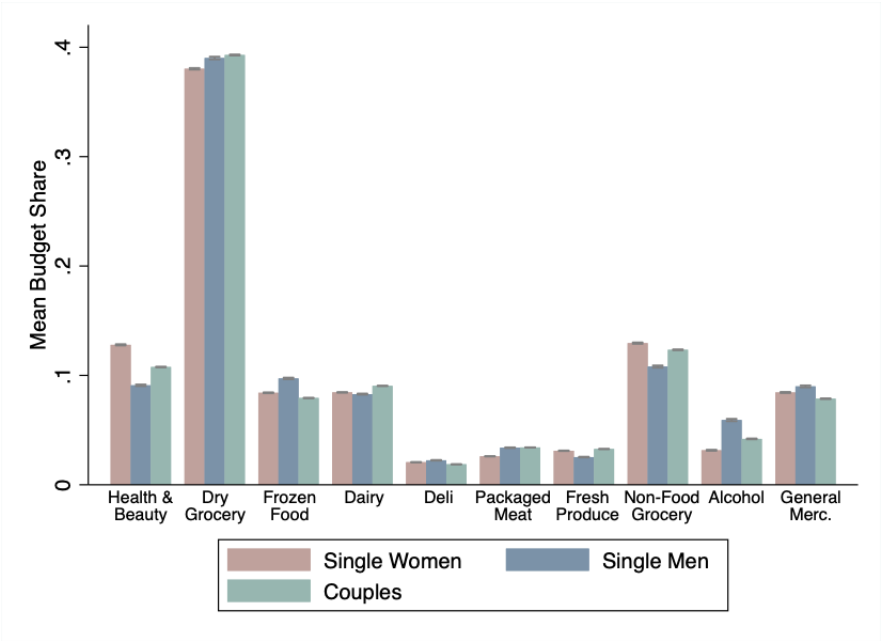
Note: Nielsen Consumer Panel 2004-2017. Sample is limited to couples whose both husband and wive are age 25-64. Dollars are inflation-adjusted and based on 2010 dollars.

Appendix Table A2 shows summary statistics of our married couple sample from the Nielsen Consumer Panel. Average household income is approximately $69,633 in 2010 USD among the households in our sample. Average age of our sample is 49.7 for husbands and 48.0 for wives. Years of education

are 14.38 and 14.58 for husbands and wives, respectively. Household size is on average 3.13, suggesting that the sample includes households with children. Unemployment of wives is twice higher than of husbands.

Figure 2 compares the mean budget share of married couples with single women and men. For more straightforward comparison between couples and singles, we only include couples without children and singles living alone in this figure. On average, married couples allocates more budget share on dry grocery, dairy, packaged meat, and fresh produce than singles do. Moreover, on average, married couples allocates less budget share on frozen food, deli, and general merchandise than singles do. On certain aggregate goods including health and beauty aids, alcohol, and non-food groceries, married couples' budget shares are in between single women's and single men's budget shares.

Figure 2: Mean Budget Shares by Gender, Singles and Couples Without Child



Note: Nielsen Consumer panel 2004-2017. Sample is limited to single men and women living alone and couples without child. Sample only includes those aged 25-64. This plot shows the mean budget share for each consumption categories. 95% confidence intervals are indicated by the error bars.

To disentangle the effects of marital status from effects of other household characteristics, we regress each expenditure share on each aggregate good on a married couple indicator, while controlling for various household-level characteristics including head's age, head's years of education, head's unemployment status, household income, race, as well as year and county fixed effects. Appendix Figures A2a and A2b show the regression coefficients on married couple indicator using different sub-

samples. When compared to single women, married couples allocate significantly lower budget shares on health and beauty aids, non-food grocery, and general merchandise, and significantly higher budget shares on dry grocery, dairy packaged meat and alcohol. When compared to single men, married couples allocate significantly higher budget shares on health and beauty aids, dry grocery, dairy, fresh produce, non-food grocery, and significantly lower budget shares on frozen food, deli, alcohol, and general merchandise.

Figures A2a and A2b show that the aggregate goods in which the coefficients of married couples move in the opposite directions when compared to single women and to single men are: health and beauty aids, non-food grocery, and alcohol.

5 Spouse Relative Education and Married Couple's Consumption

In this section, we examine the effects of spouse relative education on consumption of married couples. Figure A5 presents the distribution of differences of wife's and husband's years of educations in our married couple sample. It shows that around 40 percents of couples have same levels of education, and more than quarter of couples have wive more educated than the husbands. Using our married couple sample, we regress each expenditure share of each aggregate good on spouse relative education, defined by differences in years of education between wife and husband, while controlling for husband's years of education and also for various other household-level characteristics[13] and year and county fixed effects.

Figure 3 presents the regression coefficients on education difference between wife and husband.[14] Results show that higher relative wife's education, controlling for husband's education level, is associated with significantly higher budget shares on health care, on beauty products, on non-food grocery, and and on books, stationary, and school supplies. Higher relative wife's education is also associated with significantly lower budget share on alcohol and on tobacco and tobacco-related accessories. For most of these results, the relative education results seem consistent with the bargaining power story; for instance, beauty goods are more associated with female and alcohol is more associated with male,

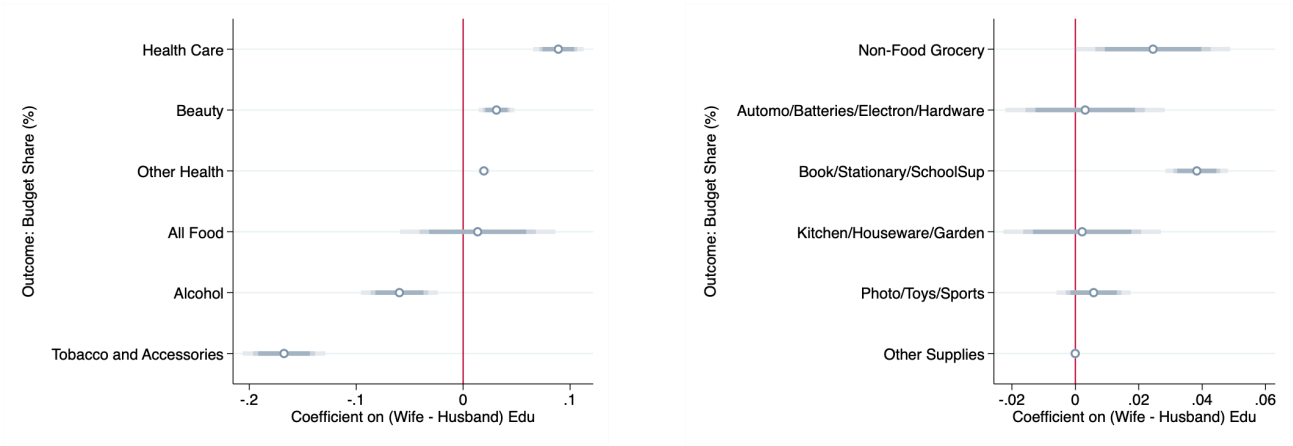
[13] These other control variables include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, and occupation fixed effects for male and female heads, which include unemployment as an omitted category.

[14] Table versions of these regression results are presented in Appendix Table A4 and A6. We also show results using the same control set but without controlling for husband's education in Appendix Tables A5 and A7. We find similar results on beauty and alcohol budget shares even if we do not control for husband's education.

according to our descriptive statistics on single males and females in Section 4.1.

While the results exhibit interesting patterns, we need to be cautious with interpretations of our relative education results on consumption. A potential concern is that spouse relative education may not be exogenous, because couples do not match randomly based on education. Couples who match assortatively based on education may have different consumption preferences than couples who do not match with similarly educated partners. In order to address this potential endogeneity concern, we construct a spouse relative potential wage, which is a plausibly more exogenous measure of spouse bargaining power. This is discussed in the next section.

Figure 3: Effects of (Wife - Husband) Education on Household Budget Share



(a) Aggregate Good I

(b) Aggregate Good II

Note: This figure presents coefficient on (wife-husband) education. Sample is married couples whose both husband and wife aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: years of education of male head, household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, occupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

6 Spouse Relative Potential Wage and Married Couple's Consumption

6.1 Construction of Gender Relative Potential Wage

To address potential endogeneity problems of using household level relative education, we construct a potential market (county) level relative wage using a Bartik-style approach, exploiting historical sex

and race segregation by industry (Bartik, 1991; Blanchard et al., 1992; Aizer, 2010; Bertrand et al., 2015; Shenhav, 2021).[15] Specifically, average annual wages are calculated by gender and race in each county as follows:

$$\bar{w}_{grecy} = \sum_{j} \gamma_{grecj} w_{-cyj} \tag{1}$$

where g, r, e, c, y, and j indicate gender, race, education (less than college or college+), county, year and industry, respectively. γ_{grecj} is the proportion of female (or male) workers of a given race and education working in industry j in county c and fixed over time to account for sorting through wages. To capture labor demand shocks uncorrelated with county specific characteristics, we construct w_{-cyj} as yearly state annual wage in industry j except for county c.

Taking out the focal county from the state annual wage is important to rule out the cases where characteristics of men and women in a particular market are affected by consumption, which is our outcome variable. For example, households in county c that consume more alcohol may be less productive, which may affect wage in county c. Our measure of average annual wages in county c removes this type of possibilities by taking the state-average wage except for county c.

With the constructed Bartik-style wage, the identification comes from the fact that the counties with higher shares in industry j which experiences large statewide wage growth will have larger increases in average wages than counties more concentrated with low-wage growth industries.

Our measure of gender wage ratio is the ratio of female to male wages constructed according to the above formula. We match the constructed gender wage ratio with the household consumption data based on gender, race, and education of each spouse annually for each county. Mean spouse wage ratio is 0.94 and the standard deviation is 0.09 in our married couple sample. 25th percentile is 0.90 and 75th percentile is 0.97.

6.2 Empirical Specification

To estimate the impact of the gender wage gap on household consumption for the married couples, we use the gender wage ratio that is constructed for each couple using Bartik measure for female and male potential wages as described in Section 6.1. Specifically, we first match the Bartik gender wage

[15] Table A3 shows different industry distributions for men and women.

to each spouse in our married couple sample by year, race, education, and county. Then, the resulting gender wage ratio for each household becomes:

$$GenderWageRatio_{re_he_wcy} = \frac{\bar{w}_{female,re_wcy}}{\bar{w}_{male,re_hcy}}$$

where h indexes household, c county, y year, r race, e_h husband's education, and e_w wife's education.

The following model is estimated using the matched consumption and wage data for the period 2004 to 2017:

$$BudgetShare_{hcy} = \alpha + \beta GenderWageRatio_{re_he_wcy} + \gamma \mathbf{X}_{hy} + \theta_c + \pi_y + \varepsilon_{hyd} \tag{2}$$

where budget share is defined as expenditure on certain aggregate good divided by total expenditure for each household in each year. The household-level control set $\mathbf{X}$ includes: household total expenditure,[16] black, Hispanic, household size, number of children in the household, ages of male and female heads, occupation dummies of female and male heads, years of education for male and female heads. Year fixed effects and and county fixed effects are included. Therefore, we exploit variations in gender wage gap within counties over time after accounting for year effects common to all counties. We use the constructed gender wage ratio in the reduced from rather than using it as an instrumental variable, allowing for different mechanisms through which the wage gap affects consumption patterns.

In order to further understand the respective effect of each gender potential wage, we also estimate the above regression using constructed male and female potential wages together as variables of interest instead of gender wage ratio. The second equation to be estimated is:

$$BudgetShare_{hcy} = \alpha + \beta_m MaleWage_{re_hcy} + \beta_f FemaleWage_{re_wcy} + \gamma \mathbf{X}_{hy} + \theta_c + \pi_y + \varepsilon_{hyd} \tag{3}$$

This would allow us to see the effects of an increase in husband's potential wage while fixing wife's potential wage on household consumption, and vice versa.

[16] Controlling for total expenditure, instead of household income, is a common practice in the budget share regressions. However, we also estimate Equation (2) using household income as a control variable instead and find very similar results. These results are available upon request.

7 The Impacts of Relative Wage on Household Consumption

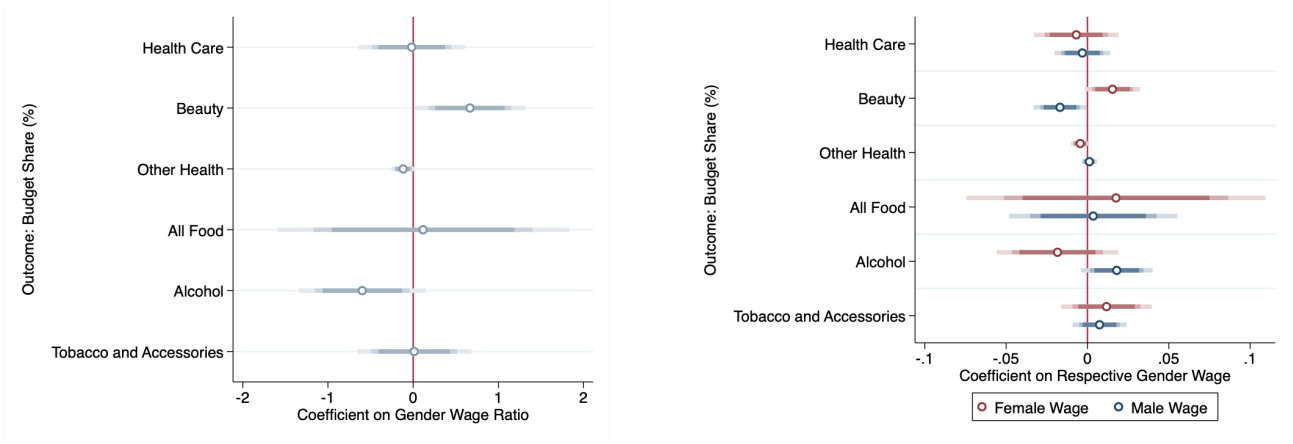
7.1 Aggregate Goods I: Health and Beauty, Food, Alcohol, Tobacco

In this section, we present the estimation results from regressing Equation 2. Figure 4a reports the regression coefficient on female-to-male wage ratio for the following Nielsen departments: health and beauty aids, food, alcohol, and tobacco and accessories.[17] Full regression results and raw mean of each budget share are reported in Appendix Table A9. The results shows that an increase in the female-to-male wage ratio is associated with an increase in budget share for beauty and a decrease in budget share for alcohol, both of which are statistically significant at the 1% level. The magnitude of these effects is considerable: considering that one standard deviation of gender wage ratio is 0.085 in our data, budget share on beauty (mean budget share: 3.5%) increases by 0.057 percentage point and budget share on alcohol (mean budget share: 2.8%) decreases by 0.051 percentage point as the wage ratio increases by one standard deviation. There is a less statistically significant effect on "Other Health" category, which mostly includes men's toiletries. The effects of gender wage ratio on other consumption categories are insignificant.

To further understand the finding, we estimate Equation 2 on the same set of outcomes using respective gender wages instead of female-to-male wage ratio. Figure 4b presents the coefficients on female and male potential wages. Table version of these results is reported in Appendix Table A9. The result shows that female wage and male wage have opposite effect on beauty budget share. Fixing the male wage, an increase in female wage significantly increases beauty budget share of the households. Fixing the female wage, an increase in male wage significantly decrease beauty budget share, both statistically significant at the 5% level. Moreover, male and female wages have opposite effects on the budget share for alcohol; an increase in male wage increases alcohol budget share, which is statistically significant at 5% level, while an increase in female wage is associated with a decreasing effect on alcohol, although the effect on female wage is not statistically significant. The result also shows that an increase in female wage has a statistically significant decreasing effect on "Other Health" budget share.

[17] We divide "Health and Beauty Aids" department into three sub-categories using product group categorization. Specifically, "Health Care" includes cough and cold remedies, diet aids, first aid, sanitary products, vitamins. "Beauty" includes cosmetics, fragrances for women, hair care, skin care preparation, shaving needs. "Other Health" includes men's toiletries and baby needs.

Figure 4: Results on Overall Consumption Budget Share, Aggregate I



(a) Female-to-Male Wage Ratio

(b) Respective Gender Wages

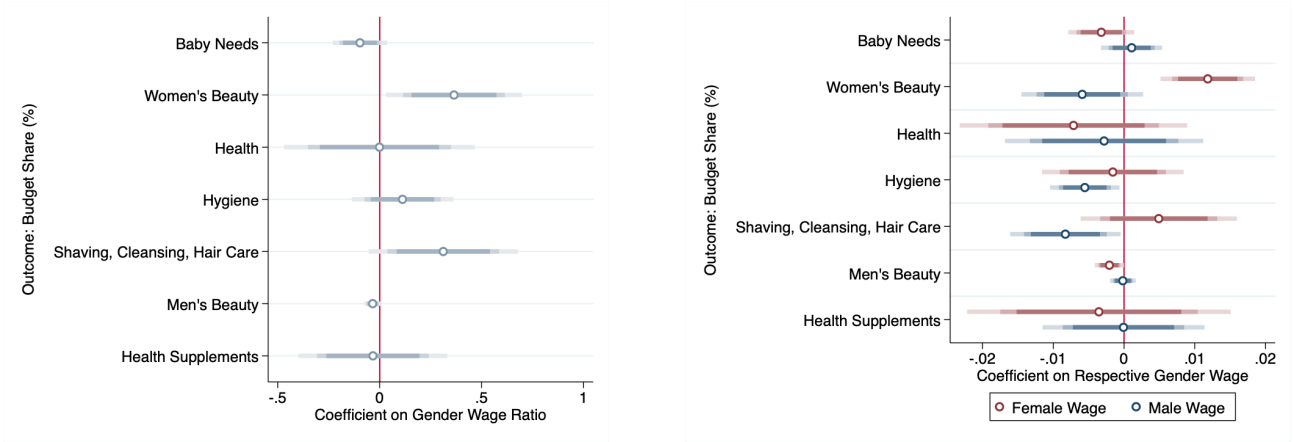
Note: This figure presents coefficient on gender wage ratio in Panel (a) and coefficients on female and male wages in Panel (b) from the corresponding regressions using Equation 2. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of female and male heads, occupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

Recall that the evidence from Section 4, which compares consumption pattern of single men and women, suggests beauty is more likely to be female good and alcohol is more likely to be male good. Our results on married couple households suggest that an increase in female-to-male wage ratio affects household budget share in a way that is more favorable to wives through increasing budget share for beauty and decreasing budget share for alcohol.

To better understand the above results, we further categorize aggregate goods into finer categories using the product module definition given by Nielsen. These more detailed aggregate goods better reflect the gender association of each aggregate good. For example, some product modules explicitly document their gender association, such as "Women's gift sets & skin care packages" and "Women's hair spray." Along with these explicitly documented gender goods, we categorize other cosmetics-related product modules that are largely used by women, such as lipsticks and nail polish, as "Women's Beauty" goods. In Figure 5, we present results for more detailed categories of health and beauty aids. Table versions of the results and mean budget shares are reported in Appendix Tables A14 and A15. Figure 5a shows that higher female-to-male wage ratio significantly increases household budget shares

on women's beauty items and shaving, cleansing, and hair care items. This result confirms that the positive effect on beauty good that we see in Figure 4a is indeed driven by items more associated with women. Figure 5b shows that for women's beauty goods and shaving, cleansing, and hair care, the effects of female potential wage and male potential wage move in the opposite direction.

Figure 5: Results on Overall Consumption Budget Share, Detailed Health and Beauty Aids



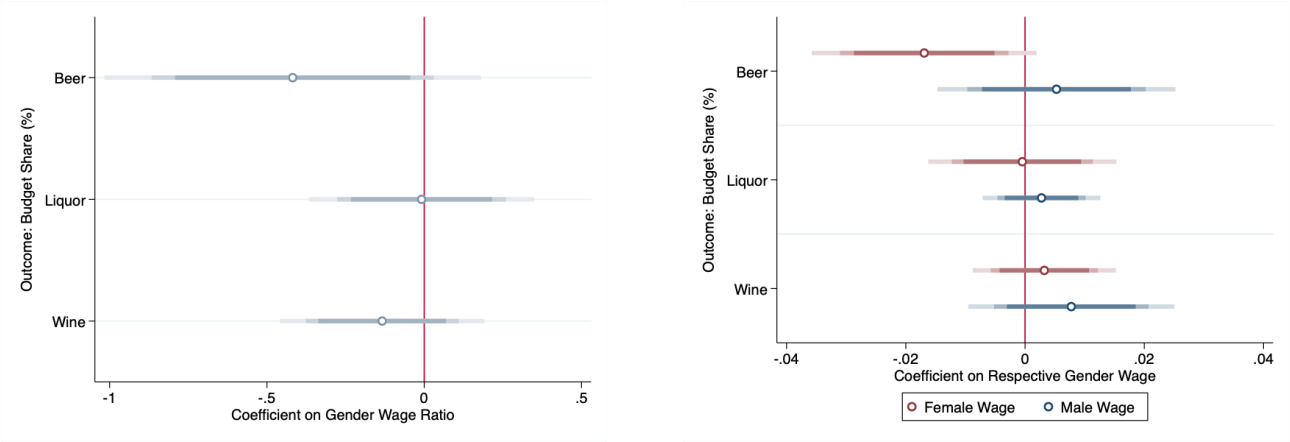
(a) Female-to-Male Wage Ratio

(b) Respective Gender Wages

Note: This figure presents coefficient on gender wage ratio in Panel (a) and coefficients on female and male wages in Panel (b) from the corresponding regressions using Equation 2. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of female and male heads,o ccupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

We also present results for detailed categories of alcohol. Figure 6a shows that higher female-to-male wage ratio decreases the household budget share on beer, and this effect is statistically significant at 5% level. We do not see statistically significant effect on liquor and on wine. This result is interesting as beer is a good that single men seems to prefer more than single women do (Figure A3). Figure 6b shows that fixing male potential wage, increase in female potential wage decreases the household budget share on beer, and this effect is statistically significant at 5% level. Another interesting pattern is that, although statistically insignificant, coefficients on male wage are all positive, while coefficient on female wage is only positive for wine, which is a good that we do not see gender differences when using single sample (Figure A3).

Figure 6: Results on Overall Consumption Budget Share, Detailed Alcohol



(a) Female-to-Male Wage Ratio

(b) Respective Gender Wages

Note: This figure presents coefficient on gender wage ratio in Panel (a) and coefficients on female and male wages in Panel (b) from the corresponding regressions using Equation 2. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of female and male heads,o ccupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

Overall, our results on all consumption categories support that higher relative female wage is associated with higher budget share for consumption categories that are likely to be more preferred by wives.

7.2 Aggregate Goods II: Non-Food Grocery and General Merchandise

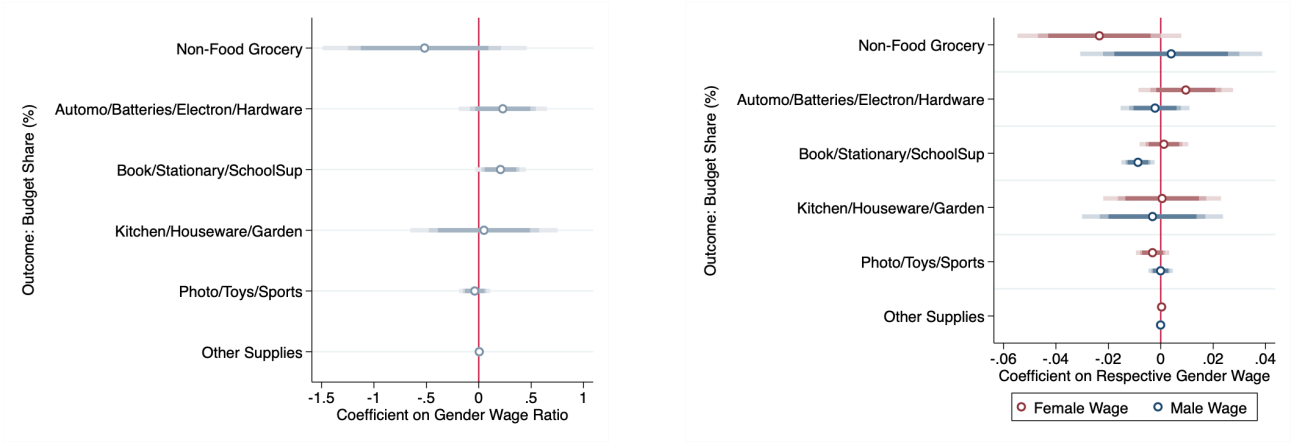
We now present the estimation results for the remaining consumption categories, which are non-food grocery and general merchandise.[18] Figure 7a and Appendix Table A10 show the estimation results using the female-to-male wage ratio as a main explanatory variable. The only statistically significant effect of gender wage ratio is shown for the budget share for "Books, Stationary, and School Supplies."

Figure 7b and Appendix Table A11 shows the estimation results for the same outcomes with respective gender wages as main variables of interest instead of gender wage ratio. Result shows that an increase in female wage has statistically significant decreasing effect on the budget share for

[18] We divide "General Merchandise" into several subcategories, which are (1) Automotive, Batteries, Electronic, Hardware, (2) Books, Stationary, School Supplies, (3) Kitchen, Houseware, Garden Supplies, (4) Photographic, Toys, Sporting goods, and (5) Other Supplies.

non-food grocery, which includes household cleaning supplies, laundry supplies, detergents, etc. An increase in male wage significantly decreases the budget share for books, stationery, and school supply.

Figure 7: Results on Overall Consumption Budget Share, Aggregate II



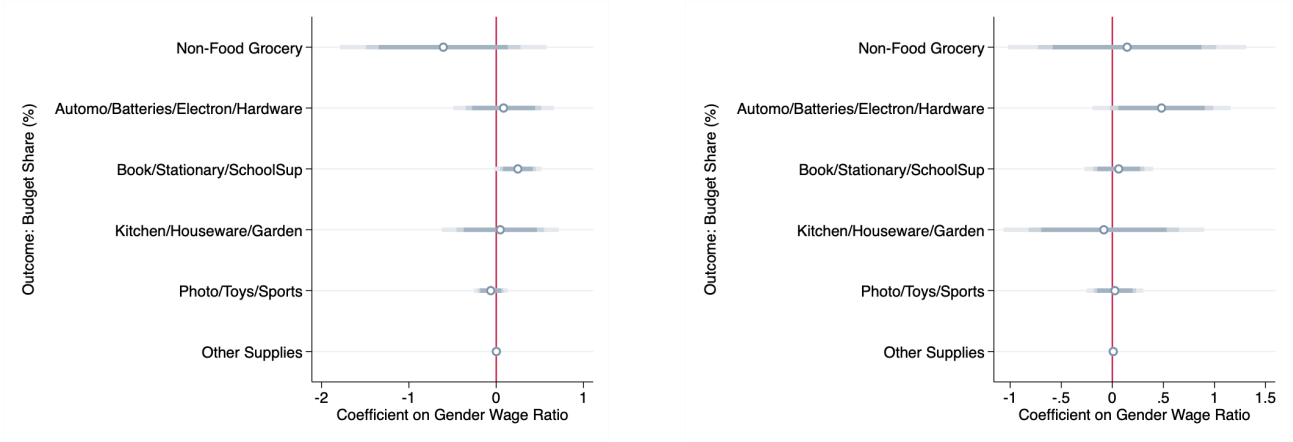
(a) Female-to-Male Wage Ratio

(b) Respective Gender Wages

Note: This figure presents coefficient on gender wage ratio in Panel (a) and coefficients on female and male wages in Panel (b) from the corresponding regressions using Equation 2. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of female and male heads, occupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

In order to further investigate whether the positive effect of gender wage ratio on "Books, Stationary, and School Supplies" are related to child investment, we divide the sample into couples with child(ren) and couples without any child. Figure 8a shows the effect of gender wage ratio for couples with child(ren), and Figure 8b shows the effect for couples without child. We see that the significantly positive effect on "Books, Stationary, and School Supplies" only exist for couples *with* child(ren). This result may be consistent with previous literature that find a higher bargaining power of wives lead to greater spending on children (Lundberg et al., 1997; Duflo, 2003). We plan to further investigate the items in this category to see if this result indeed reflects the investment in children.

Figure 8: Results on Overall Consumption Budget Share, Aggregate II, By Child Status



(a) Couples with Child(ren)

(b) Couples without Child

Note: This figure presents coefficient on gender wage ratio using different subsamples by child status from the regression using Equation 2. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of female and male heads, occupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

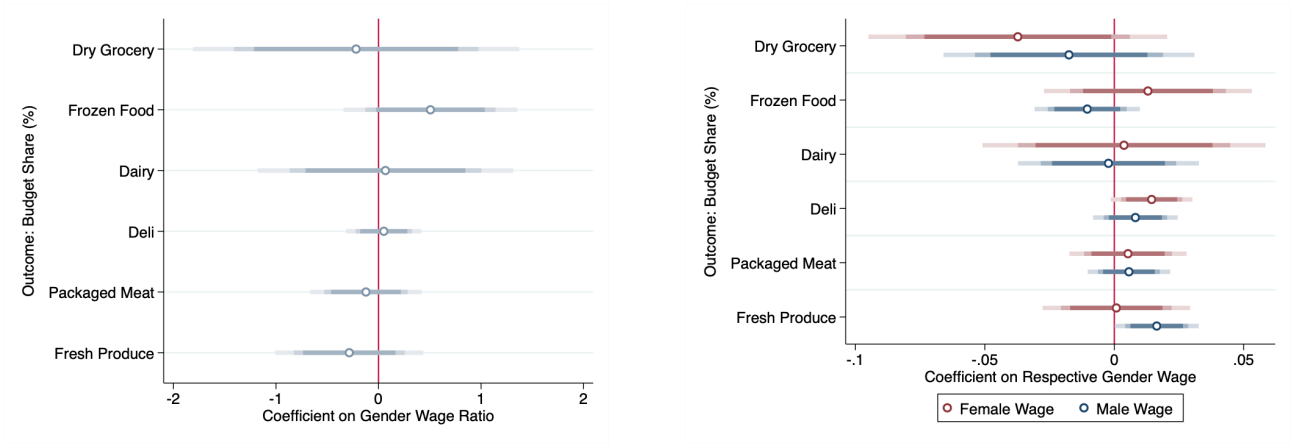
7.3 Food Consumption Categories

We now investigate results on food consumption. The results presented in this section is estimated from Equation 2 where each outcome variable is defined as food budget share for each food category. Food budget share is calculated by dividing the expenditure of each food categories by the total expenditure on food. Figure 9a and Appendix Table A12 present the regression results where the female-to-male wage ratio is the variable of interest. We find that there are no statistically significant effects of gender wage ratio on each food budget share, although there is a limited evidence that frozen food budget share seems to increase.

Figure 9b and Appendix Table A13 present the estimation results for food budget share with respective gender wages as main variables of interest. Coefficients on female and male wages are not statistically significant for most outcomes. An increase in female wage is associated with a significant decrease in budget share for dry grocery and a significant increase in budget share for deli. An increase in male wage is associated with a significant increase in fresh produce budget share. However, as discussed in Section 3, fresh produce is imprecisely measured in our sample.

Because each food category may contain products of heterogeneous nutritional quality, it is difficult to interpret our current findings on food consumption in terms of healthy diet. In our future analyses, we plan to look at finer categories of food consumption to better understand the role of relative potential wage on household nutritional outcomes.

Figure 9: Results on Food Budget Share



(a) Female-to-Male Wage Ratio

(b) Respective Gender Wages

Note: This figure presents coefficient on gender wage ratio in Panel (a) and coefficients on female and male wages in Panel (b) from the corresponding regressions using Equation 2. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. Omitted control variables from the figure include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of female and male heads,occupation fixed effects for male and female heads, county fixed effects, year fixed effects. Household weights are applied. The empty circle represents the value of corresponding regression coefficient, and the associated horizontal bars represent statistical significance level at 1% (lightest color), 5% (medium color), and 10% (darkest color) respectively. Standard errors are clustered at the state level.

8 Robustness

8.1 Alternative Channels

Our results for married-couple households show that an increase in female to male wage ratio affects household consumption on non-food categories in a way that is more favorable to wives. A prominent mechanism explaining these results is a higher bargaining power of wives within the households. However, there could be other potential channels at work. For instance, changes in total family income level induced by changes in gender wage ratio may lead to different consumption patterns. Another possible channel driving our results on household budget shares is the changes in labor supplies of men

and women that are induced by the changes in gender wage ratio.

We test the income channel by examining the impacts of gender wage ratio on total income or expenditure of households. Because household income in Nielsen Consumer Panel is reported with a two-year lag, we test the income channel using both contemporaneous income and the originally reported income in the two-year lag. Table 2 presents the regression result with household contemporaneous income (Column (1)), originally reported household income with a two-year lag (Column (2)), and total household expenditure (Column (3)) as outcome variables. The result shows that the gender wage ratio does not have a statistically significant effect on either household income or total expenditure of married couples. This finding rejects the explanation that our main results in Section 7 are driven by the increase in household income or expenditure.

We currently have not examined whether the labor supply channel explains our results. It is possible that the higher female-to-male potential wage ratio has induced wives to work more. This may increase the beauty consumption if make-ups are valuable inputs for work. However, the labor supply channel does not explain why the female and male potential wage have opposite effects on alcohol budget share. In our future analyses, we plan to examine the link between gender wage ratio, changes in labor supplies, and household consumption using data containing labor supplies of husbands and wives (e.g. ACS, PSID).

Table 2: Effect of Gender Wage Ratio on Household Outcomes

	(1) Income (1,000 USD) b/se	(2) Income (1,000 USD), 2 Year Lag b/se	(3) Total Expenditure (1,000 USD) b/se
(Female Wage)/(Male Wage)	-1.2280 (1.9517)	-1.0191 (1.3889)	-0.0670 (0.1227)
Observations	192222	332403	332403
Controls	Yes	Yes	Yes
County FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R-squared	0.429	0.442	0.123

Note: 2004-2017 Consumer Panel. Sample is married couples with both wife and husband aged 25-64 in 2004-2017 Nielsen Consumer Panel. All dollars are inflation-adjusted and in 2010 dollars. Omitted control variables from the table include: all the demographic controls, county fixed effects, year fixed effects. Household weights are applied. Standard errors are clustered at the state level.

8.2 Placebo Checks Using Singles Living Alone

In order for the bargaining power channel for couples to be valid, we should not expect the opposite gender wage to affect the expenditure share of singles living alone, because they do not have someone else in the household to bargain with. As a placebo test, we examine if relative gender wage affect consumption of single individuals living alone. In this exercise, we limit our sample to age age 25-64 singles who are living alone. We match the singles sample to the Bartik wage data for their own gender based on year, county, education level, and race. We also match the opposite gender wage for same year, county, education level, and race to the singles sample. Using the matched data, we estimate the Equation 3 for single men and women, respectively. The results are presented in Table 3.

The results show that the opposite gender wage do not have a statistically significant effect on any of the consumption outcomes for single sample. Table 3 shows that although female's potential wage has a statistically significant positive effects on single female's beauty consumption, male's potential wage does not have significant effect on any of the female consumption. Similarly, it also shows that although the increase in male potential wage has a positive effect on single male's alcohol consumption – significant at the 10% level, female potential wage does not have any statistically meaningful effect on single male's consumption. In Appendix Table A16, we show that the gender wage ratio also does not have any significant effect on single's consumption. We view these results as further confirming that the relative gender wage only influences married couple's consumption.

Table 3: Effect of Respective Gender Wage on Budget Share (%), Singles Living Alone

	(1) Health Care	(2) Beauty	(3) Other Health	(4) All Food	(5) Alcohol	(6) Tobacco and Accessories
Panel A: Single Female Living Alone						
Female Wage (1,000 USD)	0.020	0.060**	-0.000	-0.045	-0.018	-0.012
	(0.032)	(0.028)	(0.003)	(0.082)	(0.029)	(0.072)
Male Wage (1,000 USD)	-0.022	-0.042	0.001	-0.017	0.023	0.055
	(0.030)	(0.026)	(0.003)	(0.063)	(0.026)	(0.040)
Budget Share Mean (%)	8.302	4.342	0.170	62.550	3.159	2.541
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	82267	82267	82267	82267	82267	82267
Panel B: Single Male Living Alone						
Female Wage (1,000 USD)	0.048	0.011	-0.000	-0.085	-0.128	0.094
	(0.045)	(0.029)	(0.005)	(0.188)	(0.095)	(0.079)
Male Wage (1,000 USD)	0.001	-0.001	-0.002	0.080	0.121*	0.002
	(0.047)	(0.018)	(0.002)	(0.143)	(0.071)	(0.064)
Budget Share Mean (%)	6.845	2.109	0.163	65.091	5.938	3.209
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	41401	41401	41401	41401	41401	41401

Note: 2004-2017 Consumer Panel. In Panel A, the sample is limited to single females aged 25-64 living alone. In Panel B, the sample is limited to single males aged 25-64 living alone. Control variables include: total expenditure, dummies for black and hispanic, age, years of education, occupation categories. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

8.3 Rotemberg Weight

We conduct the robustness check proposed by Goldsmith-Pinkham et al. (2020) to document the variation that drives our Bartik estimates for each gender's potential wage. Rotemberg weight measures the relative importance of each industry share in determining parameter estimates. These weights are calculated by decomposing the Bartik estimator into a weighted combination of just-identified estimates based on each industry share. Because our measure of female-to-male potential wage ratio is constructed in a way that cannot be decomposed into a combination of industries, we instead decompose the estimators for female potential wage and male potential wage, respectively. Specifically, we examine which industries contribute most to parameter estimates for β_m and β_f, respectively, when estimating Equation 3. For the calculation of Rotemberg weights for each gender wage, we select two outcomes that show highly statistically significant coefficient on each gender wage in Section 7. Outcomes selected for female potential wage are: household budget shares on women's beauty items

and on beer. Outcomes selected for male potential wage are: household budget shares on women's beauty items and on alcohol. We describe the detailed estimation procedure for the Rotemberg weights in Appendix B.

Rotemberg weights are reported in Appendix Table A17 for female potential wage and Appendix Table A18 for male potential wage. In Part I of each panel, we show the proportion of positive and negative Rotemberg weights for each industry. Both tables show that the share of negative weights are very small, which means our Bartik estimates do have a LATE-like interpretation as weighted averages of treatment effects as explained in Goldsmith-Pinkham et al. (2020). In Part II of each panel, we show top 5 industries for each gender potential wage. Note that the Rotemberg weights are not the function of outcome variables as outlined in Appendix B, and hence they are same across outcomes in each table. Although no single industry is contributing to the majority of the identifying variation for each gender's potential wage, top five Rotemberg industries account for a big proportion of the positive weight in the estimator, over 93% for female potential wage and 79% for male potential wage. However, we observe that point estimates across top five instruments are very similar and close to overall point estimates for the main outcomes, and this confirms that no single industry is driving the point estimate of our Bartik estimator.

9 Structural Estimation: The Impacts of Relative Wages on Couples' Sharing Rule

In previous sections, we showed how relative wages affect expenditures on different categories. In this section, we study how relative wages influence couples' sharing rule (i.e., how couples split resources within households). Specifically, we use a structural model with a collective model approach which allows us to recover how sharing rule responds to relative wages. The identification is based on the results from Chiappori et al. (2002).

Model

We assume egoistic preferences where each agent cares only about his or her own consumption.[19] The utility function can be represented as $u^i(\mathbf{q}^i, \mathbf{s})$ where i denotes the agent (i.e., $i = h, w$). $\mathbf{q}^i$

[19]The model can be extended to have Beckerian "caring" preferences.

and $\mathbf{s}$ indicate the consumption of agent i and preference factors such as age and education level, respectively. $\mathbf{q}^i$ can be either gender-exclusive goods or assignable goods from which we can observe individual consumption patterns. We assume a well-behaved utility function that is strictly quasi-concave, increasing, and continuously differentiable. We assume that the agents face the same prices.

The household solves the following program:

$$\max_{\mathbf{q}^h, \mathbf{q}^w} u^h(\mathbf{q}^h, \mathbf{s}) + \mu(\mathbf{s}, \mathbf{z}) u^w(\mathbf{q}^w, \mathbf{s}) \tag{4}$$

subject to

$$\mathbf{e} \cdot (\mathbf{q}^h + \mathbf{q}^w) \leq x$$

where $\mathbf{e}$, $\mathbf{s}$, $\mathbf{z}$, and x denote a price vector of ones, a vector of preference factors, a vector of distribution factors, and total expenditure, respectively. Pareto weight μ is a function of $\mathbf{s}$ and $\mathbf{z}$ and is assumed continuously differentiable with respect to each argument. Note that distribution factors, $\mathbf{z}$, affects consumption choice only through μ. In other words, when $\mathbf{z}$ changes, the allocation moves along the Pareto frontier without changing the Pareto frontier.

Under the egoistic preference assumption, the above problem is equivalent to solving two problems of husbands and wives. That is, there exist *sharing rule* functions $\phi^h(x, \mathbf{s}, \mathbf{z})$ and $\phi^w(x, \mathbf{s}, \mathbf{z})$ such that $\phi^h + \phi^w = x$. Each member solves the program below:

$$\max_{q^i} u(\mathbf{q}^i, \mathbf{z}) \tag{5}$$

subject to

$$\mathbf{e} \cdot \mathbf{q}^i \leq \phi^i$$

where $i = h, w$. The result follows from the second fundamental theorem of welfare economics. Any Pareto efficient allocation can be achieved as a competitive equilibrium with a lump-sum wealth redistribution. For the complete proof, see Browning et al. (1994).

Assuming interior solutions, equation (5) yields demand equations for husbands and wives. we

focus on two gender-exclusive goods, one for the husband and one for the wife. The demand functions are as follows:

$$c^h = C^h(\phi^h(x, \mathbf{s}, \mathbf{z}), \mathbf{s}) \tag{6}$$

$$c^w = C^w(x - \phi^h(x, \mathbf{s}, \mathbf{z}), \mathbf{s}) \tag{7}$$

where C^i is a demand function for member i ($i = h, w$). These two equations allow us to identify the partials of the sharing rule. The identification result closely follows Chiappori et al. (2002). The idea is using the fact that total expenditure and distribution factors affect consumption behavior only through the sharing rule. The responses of the consumption behaviors to these variables allow us to estimate the marginal rate of substitution between x and $\mathbf{z}$ for husbands and wives.

To formalize this idea, let $A = \frac{\partial c^h/\partial z}{\partial c^h/\partial x}$ and $B = \frac{\partial c^w/\partial z}{\partial c^w/\partial x}$ when $\frac{\partial c^h}{\partial x} \cdot \frac{\partial c^w}{\partial x} \neq 0$. Assume that there is only one distribution factor. A and B are directly observable from the data. From the demand equations, $A = \frac{\partial c^h/\partial z}{\partial c^h/\partial x} = \frac{\phi^h_z}{\phi^h_x}$ and $B = \frac{\partial c^w/\partial z}{\partial c^w/\partial x} = \frac{-\phi^h_z}{1-\phi^h_x}$. Their relationships allow the recovery of the partials of sharing rule, ϕ^h_z and ϕ^h_x. They are given by the following:

$$\phi^h_x = \frac{B}{B - A} \tag{8}$$

$$\phi^h_z = \frac{AB}{B - A} \tag{9}$$

assuming that $A \neq B$.

Given the results above, the sharing rule can be identified up to a constant function $\kappa(\mathbf{z})$.

Estimation of the model

As two gender exclusive goods, we use women's and men's beauty goods.[20] We focus on married couples without children to make sure that the expenditures on gender-exclusive goods are solely for husbands and wives, not other members of the households. For the total expenditure, we use the total expenditure for Nielsen-tracked items. Therefore, we estimate how Nielsen-tracked expenditures are shared among couples, rather than how total household expenditures are shared. Note that the mean

[20] Women's beauty goods and men's beauty goods are defined using relevant product modules, which are more detailed categories than product groups. Women's beauty goods include goods such as cosmetics, female fragrances, and female hair care. Men's beauty goods include items such as male hair care and men's toiletries.

annual expenditure for Nielsen tracked items is $4,246.

We use an unrestricted linear functional form with one distribution factor given below:[21]

$$\text{Men's beauty}_{hy} = \alpha^h + \beta^h GenderWageRatio_{re_he_wcy} + \tau^h x_{hy} + \gamma^h \mathbf{s}_{hy} + \theta_c^h + \pi_y^h + \varepsilon_{hy} \quad (10)$$

$$\text{Women's beauty}_{hy} = \alpha^w + \beta^w GenderWageRatio_{re_he_wcy} + \tau^w x_{hy} + \gamma^w \mathbf{s}_{hy} + \theta_c^w + \pi_y^w + \varepsilon_{hy} \quad (11)$$

where $GenderWageRatio$ is our distribution factor z. x_{hy} is total expenditure and $\mathbf{s}_{hy}$ indicates preference factors including race dummies, household size, number of children in the household, ages of male and female heads, occupation dummies of female and male heads, years of education for male and female heads. θs and πs denote county fixed effects and year fixed effects, respectively. The dependent variables are defined as expenditure levels at the household for each gender-exclusive goods.

The partials of sharing rule are given as follows:

$$\phi_x^h = \frac{\tau_2\delta_1}{\tau_2\delta_1 - \tau_1\delta_2} \quad (12)$$

$$\phi_z^h = \frac{\tau_1\delta_1}{\tau_2\delta_1 - \tau_1\delta_2} \quad (13)$$

Finally, the sharing rule equation is given by:

$$\phi^h = \frac{\tau_2\delta_1}{\tau_2\delta_1 - \tau_1\delta_2}x + \frac{\tau_1\delta_1}{\tau_2\delta_1 - \tau_1\delta_2}z + \kappa(\mathbf{z}) \quad (14)$$

$\kappa(\mathbf{z})$ is not identifiable, thus making the sharing rule identified up to a constant.

Sharing rule estimates

In this section, we present sharing rule estimates. The results are presented in Table 4. The partials of the sharing rule with respect to total expenditures and relative wages are both statistically significant. The partial with respect to the total expenditure is 0.52. This means that when total expenditure increases by one dollar, the shares of husbands increase by 0.52 unit. Naturally, wives take 0.48 unit. However, the difference between the shares of husbands and wives is not statistically significant, suggesting that additional dollars are shared equally between husbands and wives. The partial with

[21] Any number of distribution factors can be incorporated.

respect to relative wages is estimated to be 749.6 dollars. This suggests that if relative wages increase by a standard deviation (0.085 in our data), the share of husbands decrease by 63.7 dollars, which correspond to 1.6% of the total expenditures counted in Nielsen. To understand the magnitude of the impact, we calculate income elasticities of demands for single men and women. Given the single men's income elasticity for alcohol demand, income reduction of 63.7 dollars leads to 4% decrease in alcohol expenditures. For women, income increase of 63.7 dollars results in 2.5% higher allocation on beauty goods. These estimates suggest that the changes in labor market meaningfully affect household allocations overall.

Table 4: Impacts of Gender Wage Ratio on Sharing Rule of Married Couples

	(1)
ϕ_x^h	.519***
	(.105)
ϕ_z^h	-749.586***
	(152.688)
Observations	140909

Note: This table presents the estimates of the partials of the sharing rules with respect to total expenditures and a distribution factor. We use female-to-male wage ratio as our distribution factor. Included samples are households without children. Men's beauty goods and women's beauty goods are used as gender-exclusive goods. Control variables include: total expenditure, dummies for black and hispanic, age, years of education, occupation categories. County fixed effects and year fixed effects are included. Household weights are applied. Dollars are inflation-adjusted and based on 2010 dollars. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

10 Conclusion and Next Steps

We investigate how spouse bargaining power affects the household consumption of the married couples in the US by using spouse relative education and relative gender potential wage in the local labor market as two proxies for bargaining power. The literature on household economics suggests that an increase in women's wages or education relative to mens potentially improve wives' positions within households, resulting in different consumption patterns.

We find consistent results with this bargaining power explanation: households spend more on beauty goods, which are more preferred by women, and spend less on alcohol, which is more preferred by men, when relative education or potential wages of women increase. We also find a limited evidence

that higher relative wages result in higher expenditure shares on frozen food. Given that women prefer healthier diet, this may seem surprising, but this may be explained by different labor market allocations due to changes in relative wages. Lastly, for couples with children, improved women's household bargaining position is associated with higher budget share on books, stationary, and school supplies, which are potentially related to investment in children. Our robustness checks show that these effects are not driven by income effects and only show up for couples, not singles. Hence, our view is that the spouse bargaining position channel is most likely to drive our results.

Our next steps include both reduced-form and structural estimations. First, we plan to investigate the link between gender wage ratio and changes in labor supplies to better understand if labor channel matters in interpreting our results. Second, we are planning to examine finer categories for food items to better understand the nutritional impacts of improved bargaining power of wives. Lastly, following the estimation framework of Browning et al. (2013), we plan to estimate the level of sharing rule for each spouse and conduct counterfactual analyses to assess the impacts of policies promoting gender equality and perform welfare calculations.

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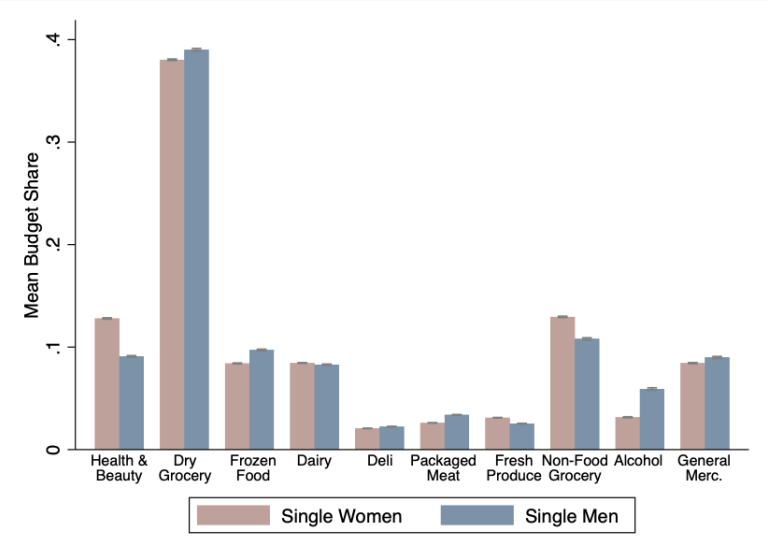
A Appendix

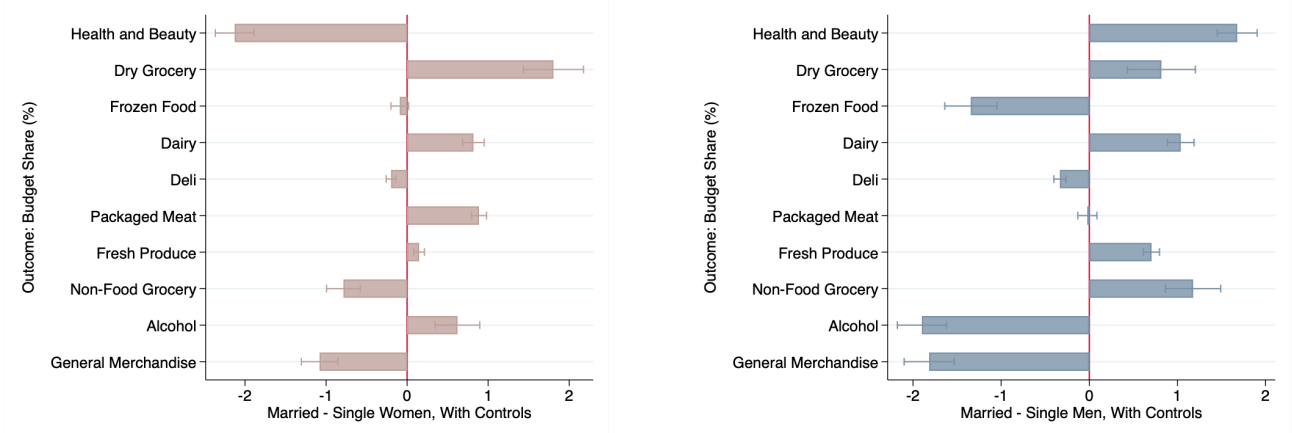
A.1 Additional Figures

Figure A1: Mean Budget Shares by Gender, Singles Living Alone



Note: Consumer panel 2004-2017. Sample is limited to single men and women living alone and whose age is between 25-64. This plot shows the mean budget share for each consumption categories. 95% confidence intervals are indicated by the error bars.

Figure A2: Singles vs. Couples



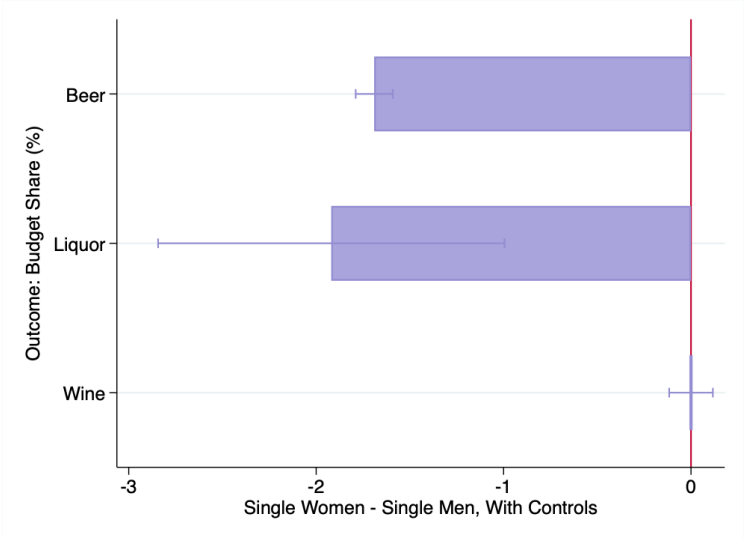
(a) Single Women vs. Couples

(b) Single Men vs. Couples

Note: Consumer Panel 2004-2017. Panel (a) includes single women living alone and between age 25-64 and couples without children and both spouses between age 25-64. Panel (b) includes single men living alone and under age 65 and couples without children and both spouses between age 25-64. This figure shows the result from regression of budget share for corresponding aggregate good (y-axis) on married couple indicator and various controls. The bar indicates the regression coefficient on the married couple indicator. Control variables included in the regressions are: household head's

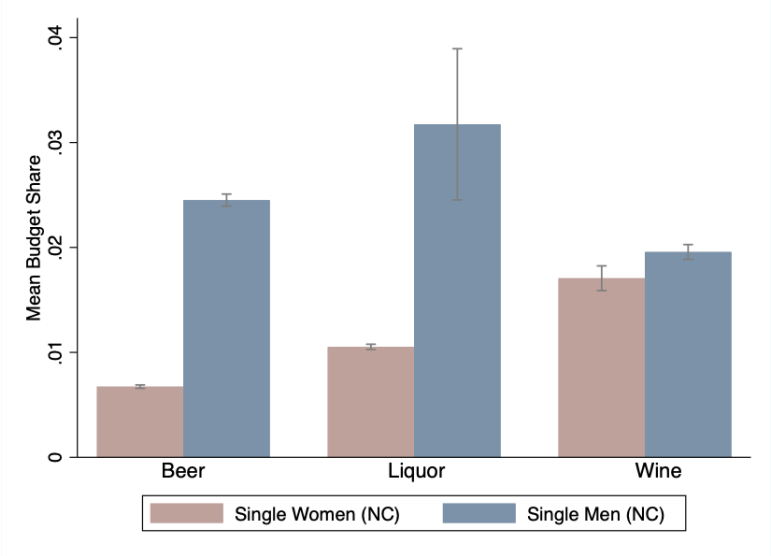
age, household head's years of education, household head's unemployment status, household income, dummies for black and hispanic, year fixed effects, county fixed effects. For married couple, household head is defined to be male head. Household weights are applied. Standard errors are clustered at the state level.

Figure A3: Consumption Patterns by Single Women vs Single Men without Children, Detailed Alcohol



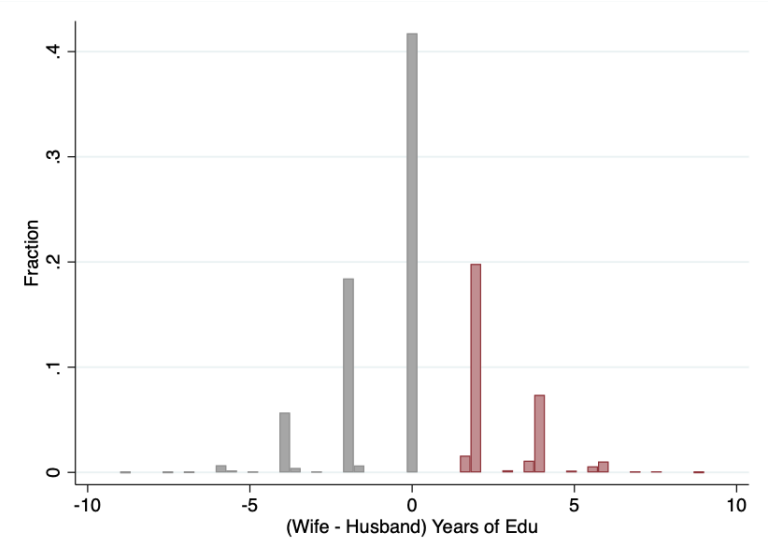
Note: Consumer Panel 2004-2017. Sample only includes singles between age 25-64 without children. This figure shows the result from regression of budget share for corresponding aggregate good (y-axis) on female indicator and various controls. The bar indicates the regression coefficient on the female indicator. Control variables included in the regressions are: age, years of education, unemployment status, household income, dummies for black and hispanic, year fixed effects, county fixed effects. Household weights are applied. Standard errors are clustered at the state level.

Figure A4: Raw Budget Share by Gender, Single Without Child



Note: Consumer panel 2004-2017. Sample is limited to single men and women without child and who are between age 25-64. This plot shows the mean budget share for each consumption categories. 95% confidence intervals are indicated by the error bars.

Figure A5: Distribution of (Wife - Husband) Years of Education



Note: Consumer Panel 2004-2017. Sample only includes couples with both spouses aged between 25-64.

A.2 Tables

A.2.1 Descriptive

Table A1: Description of Nielsen Departments

Department	**Description**
Health and Beauty Aids	e.g. baby care, cosmetics, cough & cold remedies, deodorant, hair care, oral hygiene, pain remedies, skin care, fragrances, shaving
Dry Grocery	e.g. baking mixes, bottle water, candy, carbonated beverages, cereal, coffee, condiments, crackers, pet food, prepared foods, snacks, soup, canned vegetables
Frozen Food	e.g. ice cream, frozen pizza, frozen vegetables
Dairy	e.g. cheese, eggs, yogurt
Deli	
Packaged Meat	
Fresh Produce	
Non-Food Grocery	e.g. detergent, diapers, fresheners/deodorizers, household cleaners, laundry supplies, pet care
Alcohol	e.g. beer, wine, liquor, coolers
General Merchandise	e.g. batteries/flashlights, candles, computer/electronic, cookware, film/cameras, insecticides, lawn & garden, motor vehicle, office supplies

Table A2: Demographic Characteristics of Married Couples

	(1) Married
Household Income	69633.25 (31102.8)
Household Size	3.13 (1.262)
Black	0.08 (0.265)
Hispanic	0.08 (0.268)
Age, Female Head	48.03 (9.777)
Years of Education, Female Head	14.58 (2.012)
Unemployed, Female Head	0.33 (0.471)
Age, Male Head	49.73 (9.553)
Years of Education, Male Head	14.39 (2.142)
Unemployed, Male Head	0.15 (0.360)
Observations	327957

Note: Nielsen Consumer Panel 2004-2017. Sample is limited to couples where both female and male heads are between age 25-64. Dollars are inflation-adjusted and are based on 2010 USD. Standard deviations are in parentheses.

Table A3: Industry Composition by Gender (%)

	Men	Women
Manufacturing	17.67	9.53
Construction	12.07	1.49
Retail Trade	10.58	12.57
Transporation and Warehousing	6.03	2.39
Accommodation and Food Services	6.02	8.18
Public Administration	5.68	4.51
Professional, Scientific, and Technical Services	5.51	5.50
Educational Services	4.72	11.97
Wholesale Trade	4.62	2.36
Other Services (except Public Administration)	4.49	5.11
Health Care and Social Assistance	4.23	18.56
Administrative and Support and Waste Management and Remediation Services	4.02	3.50
Finance and Insurance	3.39	6.36
Information	3.06	2.94
Agriculture, Forestry, Fishing and Hunting	2.23	0.72
Arts, Entertainment, and Recreation	1.98	1.85
Real Estate and Rental and Leasing	1.71	1.84
Utilities	1.30	0.43
Mining, Quarrying, and Oil and Gas Extraction	0.65	0.11
Management of Companies and Enterprises	0.04	0.06
Total	100.00	100.00

Note: Share of men and women in each industry is calculated using employed samples in census 2000. We follow 2-digit NAICS industry classifications. They are weighted by census population weights.

A.2.2 Main Results: Relative Education

Table A4: Effect of (Wife-Husband) Years of Education Conditional on Husband's Education on Budget Share (%), (Aggregate I)

	(1) Health Care b/se	(2) Beauty b/se	(3) Other Health b/se	(4) All Food b/se	(5) Alcohol b/se	(6) Tobacco and Accessories b/se
(Wife - Husband) Edu	0.0919***	0.0321***	0.0199***	0.0066	-0.0553***	-0.1711***
	(0.0092)	(0.0065)	(0.0021)	(0.0282)	(0.0136)	(0.0136)
Years of Education, Male Head	0.1938***	0.0280***	0.0257***	-0.1183***	0.0082	-0.3240***
	(0.0128)	(0.0099)	(0.0025)	(0.0394)	(0.0207)	(0.0224)
Observations	333834	333834	333834	333834	333834	333834
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	5.895	3.465	0.382	67.80	2.827	1.476
R-squared	0.103	0.0808	0.0745	0.138	0.112	0.128

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A5: Effect of (Wife-Husband) Years of Education on Budget Share (%), (Aggregate I)

	(1) Health Care b/se	(2) Beauty b/se	(3) Other Health b/se	(4) All Food b/se	(5) Alcohol b/se	(6) Tobacco and Accessories b/se
(Wife - Husband) Edu	-0.0071	0.0178***	0.0068***	0.0670***	-0.0595***	-0.0057
	(0.0076)	(0.0056)	(0.0018)	(0.0237)	(0.0114)	(0.0118)
Observations	333834	333834	333834	333834	333834	333834
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	5.895	3.465	0.382	67.80	2.827	1.476
R-squared	0.0987	0.0806	0.0733	0.138	0.112	0.121

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A6: Effect of (Wife-Husband) Years of Education Conditional on Husband's Education on Budget Share (%), (Aggregate II)

	(1) Non-Food Grocery b/se	(2) Automo/Batteries/Electron/Hardware b/se	(3) Book/Stationary/SchoolSup b/se	(4) Kitchen/Houseware/Garden b/se	(5) Photo/Toys/Sports b/se	(6) Other Supplies b/se
(Wife - Husband) Edu	0.0251**	0.0033	0.0379***	0.0037	0.0060	-0.0000
	(0.0095)	(0.0102)	(0.0037)	(0.0091)	(0.0046)	(0.0002)
Years of Education, Male Head	0.0187	0.0489***	0.0559***	0.0450***	0.0180***	0.0001
	(0.0169)	(0.0110)	(0.0058)	(0.0132)	(0.0048)	(0.0002)
Observations	333834	333834	333834	333834	333834	333834
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	10.80	2.670	1.251	3.147	0.279	0.00852
R-squared	0.101	0.0951	0.0524	0.0680	0.0411	0.0365

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A7: Effect of (Wife-Husband) Years of Education on Budget Share (%), (Aggregate II)

	(1) Non-Food Grocery b/se	(2) Automo/Batteries/Electron/Hardware b/se	(3) Book/Stationary/SchoolSup b/se	(4) Kitchen/Houseware/Garden b/se	(5) Photo/Toys/Sports b/se	(6) Other Supplies b/se
(Wife - Husband) Edu	0.0155	-0.0216**	0.0093***	-0.0192***	-0.0032	-0.0001
	(0.0093)	(0.0083)	(0.0033)	(0.0067)	(0.0026)	(0.0001)
Observations	333834	333834	333834	333834	333834	333834
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	10.80	2.670	1.251	3.147	0.279	0.00852
R-squared	0.101	0.0946	0.0505	0.0675	0.0408	0.0365

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

A.2.3 Main Results: Relative Potential Wages

Table A8: Effect of Gender Wage Ratio on Budget Share (%), (Aggregate I)

	(1) Health Care b/se	(2) Beauty b/se	(3) Other Health b/se	(4) All Food b/se	(5) Alcohol b/se	(6) Tobacco and Accessories b/se
(Female Wage)/(Male Wage)	-0.0176	0.6667***	-0.1168**	0.1168	-0.5976**	0.0120
	(0.2324)	(0.2426)	(0.0520)	(0.6396)	(0.2770)	(0.2494)
Observations	332403	332403	332403	332403	332403	332403
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	5.895	3.466	0.382	67.81	2.830	1.472
R-squared	0.103	0.0815	0.0748	0.138	0.112	0.128

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A9: Effect of Respective Gender Wage on Budget Share (%), (Aggregate I)

	(1) Health Care b/se	(2) Beauty b/se	(3) Other Health b/se	(4) All Food b/se	(5) Alcohol b/se	(6) Tobacco and Accessories b/se
Female Wage (1,000 USD)	-0.0068	0.0154**	-0.0044**	0.0175	-0.0184	0.0117
	(0.0097)	(0.0063)	(0.0021)	(0.0343)	(0.0139)	(0.0104)
Male Wage (1,000 USD)	-0.0031	-0.0169***	0.0012	0.0036	0.0180**	0.0074
	(0.0064)	(0.0060)	(0.0018)	(0.0193)	(0.0082)	(0.0062)
Observations	332403	332403	332403	332403	332403	332403
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	5.895	3.466	0.382	67.81	2.830	1.472
R-squared	0.103	0.0815	0.0748	0.138	0.112	0.128

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A10: Effect of Gender Wage Ratio on Budget Share (%) (Aggregate II)

	(1) Non-Food Grocery b/se	(2) Automo/Batteries/Electron/Hardware b/se	(3) Book/Stationary/SchoolSup b/se	(4) Kitchen/Houseware/Garden b/se	(5) Photo/Toys/Sports b/se	(6) Other Supplies b/se
(Female Wage)/(Male Wage)	-0.5167	0.2296	0.2074**	0.0498	-0.0384	0.0048
	(0.3626)	(0.1563)	(0.0900)	(0.2615)	(0.0553)	(0.0038)
Observations	332403	332403	332403	332403	332403	332403
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	10.79	2.668	1.252	3.144	0.279	0.00852
R-squared	0.101	0.0952	0.0526	0.0680	0.0412	0.0366

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A11: Effect of Respective Gender Wage on Budget Share (%) (Aggregate II)

	(1) Non-Food Grocery b/se	(2) Automo/Batteries/Electron/Hardware b/se	(3) Book/Stationary/SchoolSup b/se	(4) Kitchen/Houseware/Garden b/se	(5) Photo/Toys/Sports b/se	(6) Other Supplies b/se
Female Wage (1,000 USD)	-0.0234*	0.0096	0.0012	0.0005	-0.0031	0.0003*
	(0.0116)	(0.0067)	(0.0035)	(0.0084)	(0.0024)	(0.0002)
Male Wage (1,000 USD)	0.0040	-0.0022	-0.0087***	-0.0031	-0.0001	-0.0001
	(0.0129)	(0.0049)	(0.0024)	(0.0100)	(0.0017)	(0.0002)
Observations	332403	332403	332403	332403	332403	332403
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	10.79	2.668	1.252	3.144	0.279	0.00852
R-squared	0.101	0.0952	0.0527	0.0680	0.0412	0.0366

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A12: Effect of Gender Wage Ratio on Food Budget Share (%)

	(1) Dry Grocery b/se	(2) Frozen Food b/se	(3) Dairy b/se	(4) Deli b/se	(5) Packaged Meat b/se	(6) Fresh Produce b/se
(Female Wage)/(Male Wage)	-0.2185	0.5064	0.0677	0.0518	-0.1224	-0.2850
	(0.5928)	(0.3157)	(0.4643)	(0.1368)	(0.2027)	(0.2685)
Observations	332395	332395	332395	332395	332395	332395
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	59.77	12.93	14.37	3.042	5.365	4.517
R-squared	0.114	0.0882	0.154	0.0848	0.169	0.144

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied.Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A13: Effect of Wage by Gender on Food Budget Share (%)

	(1) Dry Grocery b/se	(2) Frozen Food b/se	(3) Dairy b/se	(4) Deli b/se	(5) Packaged Meat b/se	(6) Fresh Produce b/se
Female Wage (1,000 USD)	-0.0373*	0.0130	0.0038	0.0144**	0.0053	0.0008
	(0.0215)	(0.0150)	(0.0204)	(0.0059)	(0.0084)	(0.0106)
Male Wage (1,000 USD)	-0.0175	-0.0104	-0.0023	0.0082	0.0057	0.0164***
	(0.0181)	(0.0076)	(0.0130)	(0.0061)	(0.0059)	(0.0061)
Observations	332395	332395	332395	332395	332395	332395
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	59.77	12.93	14.37	3.042	5.365	4.517
R-squared	0.114	0.0882	0.154	0.0851	0.170	0.144

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A14: Effect of Gender Wage Ratio on Detailed Health and Beauty (%)

	(1) Baby Needs b/se	(2) Women's Beauty b/se	(3) Health b/se	(4) Hygiene b/se	(5) Shaving, Cleansing, Hair Care b/se	(6) Men's Beauty b/se	(7) Health Supplements b/se
(Female Wage)/(Male Wage)	-0.0969*	0.3644***	-0.0012	0.1118	0.3117**	-0.0346**	-0.0332
	(0.0495)	(0.1242)	(0.1743)	(0.0926)	(0.1361)	(0.0146)	(0.1361)
Observations	332412	332412	332412	332412	332412	332412	332412
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	0.318	1.146	3.479	1.688	1.894	0.0857	1.651
R-squared	0.0828	0.0643	0.104	0.0860	0.0794	0.0477	0.0796

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied.Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

Table A15: Effect of Wage by Gender on Detailed Health and Beauty (%)

	(1) Baby Needs b/se	(2) Women's Beauty b/se	(3) Health b/se	(4) Hygiene b/se	(5) Shaving, Cleansing, Hair Care b/se	(6) Men's Beauty b/se	(7) Health Supplements b/se
Female Wage (1,000 USD)	-0.0032*	0.0118***	-0.0071	-0.0016	0.0049	-0.0021***	-0.0036
	(0.0017)	(0.0025)	(0.0060)	(0.0037)	(0.0041)	(0.0008)	(0.0069)
Male Wage (1,000 USD)	0.0011	-0.0059*	-0.0028	-0.0055***	-0.0083***	-0.0002	-0.0001
	(0.0016)	(0.0032)	(0.0052)	(0.0018)	(0.0029)	(0.0007)	(0.0043)
Observations	332412	332412	332412	332412	332412	332412	332412
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean Budget Share (%)	0.318	1.146	3.479	1.688	1.894	0.0857	1.651
R-squared	0.0828	0.0643	0.104	0.0861	0.0794	0.0479	0.0796

Note: 2004-2017 Consumer Panel. Sample is limited to couples where both husband and wife are aged 25-64. Controls include: household total expenditure, black, hispanic, household size, number of children, ages of female and male heads, years of education of male and female heads, and occupation fixed effects for male and female heads. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

A.2.4 Additional Results

Table A16: Effect of Respective Gender Wage on Budget Share (%), Singles Living Alone

	(1) Health Care	(2) Beauty	(3) Other Health	(4) All Food	(5) Alcohol	(6) Tobacco and Accessories
Panel A: Single Female Living Alone						
(Female Wage)/(Male Wage)	0.705	1.629	-0.039	0.651	-0.863	-1.637
	(1.128)	(1.058)	(0.112)	(2.179)	(0.938)	(1.745)
Budget Share Mean (%)	8.302	4.342	0.170	62.550	3.159	2.541
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	82267	82267	82267	82267	82267	82267
Panel B: Single Male Living Alone						
(Female Wage)/(Male Wage)	-0.144	-0.007	0.065	-3.244	-5.077	0.873
	(1.886)	(0.861)	(0.110)	(5.561)	(3.122)	(2.977)
Budget Share Mean (%)	6.845	2.109	0.163	65.091	5.938	3.209
Controls	Yes	Yes	Yes	Yes	Yes	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	41401	41401	41401	41401	41401	41401

Note: 2004-2017 Consumer Panel. In Panel A, the sample is limited to single females aged 25-64 living alone. In Panel B, the sample is limited to single males aged 25-64 living alone. Control variables include: total expenditure, dummies for black and hispanic, age, years of education, occupation categories. County fixed effects and year fixed effects are included. Household weights are applied. Standard errors are clustered at the state level. *** Significant at 1% level, **: Significant at 5% level, *: Significant at 10% level.

A.3 Summary of Rotemberg Weight

Table A17: Summary of Rotemberg Weight for Female Potential Wage

Panel A: Women's Beauty Budget Share

I. Negative and positive weights

	Sum	Mean	Share
Negative	-0.106	-0.035	0.087
Positive	1.106	0.065	0.913

II. Top 5 Rotemberg weight industries

	$\hat{\alpha}_k$	$\hat{\beta}_k$	95 % CI	Ind Share
Accomm. and Food Services	0.342	0.008	[-.003, .018]	7.315
Finance and Insurance	0.205	0.013	[-.003, .031]	6.738
Retail Trade	0.188	0.016	[.002, .031]	12.144
Professional, Scientific, Technical	0.125	0.010	[-.001, .021]	5.637
Other Services	0.076	0.000	[-.018, .022]	4.957

Panel B: Beer Budget Share

I. Negative and positive weights

	Sum	Mean	Share
Negative	-0.106	-0.035	0.087
Positive	1.106	0.065	0.913

II. Top 5 Rotemberg weight industries

	$\hat{\alpha}_k$	$\hat{\beta}_k$	95 % CI	Ind Share
Accomm. and Food Services	0.342	-0.007	[-.034, .018]	7.315
Finance and Insurance	0.205	-0.027	[-.057, 0]	6.738
Retail Trade	0.188	-0.017	[-.048, .014]	12.144
Professional, Scientific, Technical	0.125	-0.013	[-.04, .021]	5.637
Other Services	0.076	0.017	[-.016, .046]	4.957

Note: This table reports statistics about the Rotemberg weights for female industry shares. Sample used to generate this table is couples where both husband and wife are aged 25-64 in 2004-2017 Consumer Panel. Panel A uses "Women's Beauty Budget Share" as outcome variable, and Panel B uses "Beer Budget Share" as outcome variable. Following Goldsmith-Pinkham et al. (2020), we report the aggregated weights, where we aggregate a given industry across years. Part I. for each panel reports the share and sum of negative weights. Part II. for each panel reports the top five industries according to the Rotemberg weights (α_k). $\hat{\beta}_k$ is the coefficient from the just-identified regression, and the 95% confidence interval is the weak instrument robust confidence interval using the method from Chernozukukhov and Hansen (2008). Ind Share is the industry share.

Table A18: Summary of Rotemberg Weight for Male Potential Wage

Panel A: Women's Beauty Budget Share

I. Negative and positive weights

	Sum	Mean	Share
Negative	-0.046	-0.023	0.042
Positive	1.046	0.058	0.958

II. Top 5 Rotemberg weight industries

	$\hat{\alpha}_k$	$\hat{\beta}_k$	95 % CI	Ind Share
Finance and Insurance	0.249	-0.007	[-.011, -.003]	3.336
Accomm. and Food Services	0.194	-0.016	[-.029, -.004]	5.479
Professional, Scientific, Technical	0.171	-0.004	[-.012, .004]	5.442
Retail Trade	0.108	-0.010	[-.02, 0]	10.660
Information	0.068	-0.018	[-.028, -.009]	3.063

Panel B: Alcohol Budget Share

I. Negative and positive weights

	Sum	Mean	Share
Negative	-0.046	-0.023	0.042
Positive	1.046	0.058	0.958

II. Top 5 Rotemberg weight industries

	$\hat{\alpha}_k$	$\hat{\beta}_k$	95 % CI	Ind Share
Finance and Insurance	0.249	0.015	[-.024, .043]	3.336
Accomm. and Food Services	0.194	0.037	[.01, .064]	5.479
Professional, Scientific, Technical	0.171	0.024	[-.002, .053]	5.442
Retail Trade	0.108	0.019	[-.02, .055]	10.660
Information	0.068	0.017	[-.004, .038]	3.063

Note: This table reports statistics about the Rotemberg weights for male industry shares. Sample used to generate this table is couples where both husband and wife are aged 25-64 in 2004-2017 Consumer Panel. Panel A uses "Women's Beauty Budget Share" as outcome variable, and Panel B uses "Alcohol Budget Share" as outcome variable. Following Goldsmith-Pinkham et al. (2020), we report the aggregated weights, where we aggregate a given industry across years. Part I. for each panel reports the share and sum of negative weights. Part II. for each panel reports the top five industries according to the Rotemberg weights (α_k). $\hat{\beta}_k$ is the coefficient from the just-identified regression, and the 95% confidence interval is the weak instrument robust confidence interval using the method from Chernozukhov and Hansen (2008). Ind Share is the industry share.

B Calculating the Rotemberg Weights

Following the general approach of the literature on gender-relative potential wage (Aizer, 2010; Bertrand et al., 2015; Shenhav, 2021), we use the Bartik-style potential wage for each gender as a reduced form measure rather than as an instrument for observed gender wage, which we do not observe in our data. Therefore, we estimate reduced form Bartik Rotemberg weights following the approach outlined in Goldsmith-Pinkham et al. (2020). We describe the estimation procedure below.

As introduced in Section 6.1, our Bartik measure for female potential wage is $\bar{w}_{female,recy} = \sum_j \gamma_{female,recj} w_{-cyj}$, and male potential wage is $\bar{w}_{male,recy} = \sum_j \gamma_{male,recj} w_{-cyj}$. We will calculate the Rotemberg weight for each industry share for each gender separately using Equation 3, which is one of our main estimation equations. For clarity, we will simplify notations here to describe how we calculate the Rotemberg weight for each gender's potential wage. Let's consider the case for female potential wage. Let us rewrite the Equation 3 as the following:

$$Y_{hy} = \beta_f B_{hy} + \mathbf{W}_{hy}\gamma + \varepsilon_{hy}$$

where Y_{hy} is the budget share of the specified aggregate good for household h in year y, B_{hy} is the female potential wage matched to wife's race r, education e_w, county c and year y, and $\mathbf{W}_{hy}$ are the controls, which include a constant, male potential wage, and all demographic controls and fixed effects as specified in Equation 3.

Goldsmith-Pinkham et al. (2020) have shown that the estimate for β_f can be written as:

$$\hat{\beta}_f = (B'B^{\perp})^{-1}(B'Y^{\perp})$$

where $B^{\perp}$ are residuals from regressing B_{hy} on $\mathbf{W}_{hy}$ and $Y^{\perp}$ are the residuals from regressing Y_{hy} on $\mathbf{W}_{hy}$. They show that as a result, it is possible to rewrite this as:

$$\hat{\beta}_f = \sum_k \hat{\alpha}_k \hat{\beta}_k, \quad \hat{\beta}_k = (\gamma_k^{female'} B^{\perp})^{-1}(\gamma_k^{female'} Y^{\perp})$$

where γ_k^{female} is the female industry share in 2000 for industry k for education level e, race r, county c, which is matched to each household. This shows that each β_k can be recovered by using the industry

share for industry k as an instrument for the reduced form Bartik measure of female potential wage.

The Rotemberg weight for each industry k is expressed as the following:

$$\hat{\alpha}_k = \frac{w_k \gamma_k^{female'} B^{\perp}}{\sum_{k'} w_{k'} \gamma_{k'}^{female'} B^{\perp}}$$

where w_k is the wage of industry k in each state in year y. Rotemberg weights for male potential wage are estimated using a similar procedure as above, using different $\mathbf{W}_{hy}$ that now include female potential wage instead of male potential wage.