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Whose money, whose time? A nonparametric approach to modeling time spent on housework

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DEPARTMENT OF ECONOMICS

Working Paper

**WHOSE MONEY, WHOSE TIME? A
NONPARAMETRIC APPROACH TO MODELING
TIME SPENT ON HOUSEWORK**

by

Sanjiv Gupta and Michael Ash

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**WHOSE MONEY, WHOSE TIME? A NONPARAMETRIC APPROACH
TO MODELING TIME SPENT ON HOUSEWORK**

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WHOSE MONEY, WHOSE TIME? A NONPARAMETRIC APPROACH TO MODELING TIME SPENT ON HOUSEWORK

ABSTRACT

We argue that earlier quantitative research on the relationship between heterosexual partners' earnings and time spent on housework has two basic flaws. First, it has focused on the effects of women's shares of couples' total earnings on their housework, and has not considered the simpler possibility of an association between women's *absolute* earnings and housework. Consequently it has relied on unsupported theoretical restrictions in the modeling. We adopt a flexible, nonparametric approach that does not impose the polynomial specifications on the data that characterize the two dominant models of the relationship between earnings and housework, the "economic exchange" and "gender display" hypotheses. Our nonparametric model allows the relationships among earnings shares, earnings, and time spent on housework to emerge from the data. A second problem with earlier studies is that they have tended to draw uniform inferences across the range of data, including regions where the data are sparse. This has led to interpretations of parametric curves that are driven by these thinly populated regions, and that may not be robust across the data. By contrast, our study explicitly assesses the reliability of results obtained in such regions. Our results provide support for an alternative model that emphasizes the importance of partners' own earnings for their housework, especially in the case of women. Women's own earnings are negatively associated with their housework hours, independently of their partners' earnings and their shares of couples' total earnings, which do not matter.

INTRODUCTION

One of the most prominent lines of inquiry in the recent quantitative literature on housework concerns the relationship between earnings and time spent on domestic labor in the context of heterosexual couple households (Akerlof and Kranton, 2000; Bittman et al., 2003; Blair and Lichter, 1991; Brines, 1994; Coverman, 1985; Davis and Greenstein, 2004; Evertsson and Nermo, 2004; Farkas, 1976; Greenstein, 2000; Parkman, 2004; Ross, 1987). Two theories have come to dominate this research, the “economic exchange” and “gender display” frameworks. Both employ the share of household or family earnings provided by each partner as an important determinant of time spent on housework. The first of these, also known as the “economic dependence” or “relative resources” perspective, proposes a straightforward association between the two variables: the greater a partner’s share of the couple’s total earnings, the less time s/he spends on domestic labor. The second, also known as the “doing gender” or “deviance neutralization” hypothesis, suggests that partners with earnings shares that are unusually high or low for their gender compensate by exaggerating their gender-normative housework performance. Men with unusually low shares spend less time on housework than other men, and women with very high shares spend more time on housework than other women.

In this paper we argue that both the exchange and display models are fundamentally flawed. Despite their differing predictions, both of these theories derive their explanatory power from the notion that housework is affected by the earnings of one partner *relative* to the other’s, usually operationalized as one partner’s share of the couple’s total earnings. Consequently, they do not account for the demonstrated importance of women’s *own* earnings, independently of their male partners’, for expenditures on substitutes for housework. Studies have shown that married women’s earnings rather than their husbands’ are associated with household spending on dining out and housecleaning services (e.g. Cohen, 1998; Oropesa, 1993). Yet the possibility of

independent relationships between women's and men's earnings on housework itself has been left virtually unexamined.

This substantive lacuna in earlier research is reflected methodologically in its reliance on unsupported theoretical restrictions in the modeling. Both the economic exchange and gender display models parametrize the relationship between earnings and housework time using first and second order polynomials in partner's share of earnings, respectively. By contrast, we use a nonparametric approach to model the relationship between earnings and housework time (Bowman and Azzalini 1997). The main advantage of nonparametric estimation is the flexibility in functional form. The estimated regression function is not forced to follow a straight line or, in the case of higher-order polynomial specifications, a parameterized curve. Our findings cast doubt on the two earlier models and lend support to an alternative which we call "her money, her time." We show that the relationship between money and housework can be described more accurately and parsimoniously by a model employing women's *absolute* earnings, considered separately from their husbands'. Our data are derived from the second wave of the National Survey of Families and Households (NSFH).

EARNINGS SHARE MODELS OF TIME SPENT ON HOUSEWORK

Economic exchange

The exchange hypothesis states that the greater a partner's share of the couple's total earnings, the less time s/he spends on housework. This idea has appeared in various forms, from the early functionalist accounts of household life (see Lopata [1993] for a succinct account) to Becker's (1991) new home economics. These theories assume that paid and unpaid labor in couple households is allocated consensually, with each partner agreeing to do more or less of each for the common good. Structural and feminist critiques of the consensual model view couple households as arenas of contention between the two partners in which income is power. How

much time one partner spends on housework is influenced by how much money s/he makes compared to the other (Blumberg and Coleman 1989; Huber and Spitze 1983). Assuming that both partners seek to minimize housework, the one with greater economic resources will do less of it. Game-theoretic approaches, which treat the performance of housework as the result of a bargaining process, also arrive at a similar conclusion (see Bittman et al. [2003] for a discussion).

Gender display

The economic exchange model is gender neutral in that both men and women are presumed to benefit in the same way from greater earnings shares. By contrast, the gender display perspective asserts that the relationship between earnings share and housework time is a function of gender. This view starts with the proposition that housework is a mechanism for affirming gender identity (West and Zimmerman 1987). Spending less time on housework is one way in which men show that they are men, for example. The need to display gender, especially in coresidential relationships with opposite-gender individuals, leads to gender-specific deviations from the predictions of the economic exchange model. Women who earn more than their male partners, and are therefore gender-atypical, may compensate by spending more time on domestic labor, not less, than more representative women who earn less than their partners. Conversely, men with earnings lower than their female partners' may spend less time on housework than other men.

Despite their differing predictions, both the exchange and the display models derive their explanatory power from measures of relative earnings. What matters to individuals' housework is not how much money they make themselves, but how much they make relative to their partners. The models used to test these two theories of the relationship between earnings and housework can be written as follows:

$$Y_i = \alpha + \beta_1 X_i + \beta_2 X_i^2 + \gamma Z_i + \epsilon_i$$

(1)

where the explanatory variable is one partner's share of the total earnings for the couple, a commonly used measure of relative resources, and i indexes couples. The vector Z_i contains other characteristics of the couple, including the ages, educational levels, and other characteristics of each partner as well as the total earnings of the couple. The linear term in relative resources, X_i , represents the exchange effect. Its coefficient is expected to be negative if partners' housework hours are inversely related to their shares of couples' total earnings. The quadratic term X_i^2 captures the curvilinearity in the relationship between relative earnings and housework that characterizes gender display. If X_i is the woman's share of total earnings, the coefficient on the quadratic term will be positive and significant if women with unusually high relative earnings do not have especially high reductions in housework, or spend more time on housework than other women.

AN ALTERNATIVE BASED ON ABSOLUTE EARNINGS

The evidence for the exchange and display models in the literature to date is mixed, as shown in Table 1. We believe that these conflicting results are due in part to two flaws in the existing research. First, previous studies have modeled the relationship between earnings share and housework hours without considering the simpler possibility of a relationship between absolute earnings and housework time suggested by the literature on intrahousehold resource allocation. Several studies have documented gender differences in the use of earnings for expenses related to the aspects of domestic life that are normatively considered to be women's responsibility, such as child care and housework. Lundberg, Pollak and Wales (1997) found that government cash payments to mothers in the U.K. in the late 1970s were associated with greater expenditures on women's and children's clothing, compared to expenditures on men's. Women's non-wage

earnings have larger effects on children's health and nutrition in some developing countries than do men's (Thomas 1990). Brandon (1999) showed that in the U.S., mothers' own earnings increased the odds of their choosing market childcare over parental care; fathers' earnings affected childcare choices only if husbands and wives pooled their earnings. Phipps and Burton (1998) reported similar findings for Canadian couples.

Specifically with regard to domestic labor, there is evidence that women's and men's earnings have differing associations with expenses for housework substitutes. Cohen (1998) found that women's earnings were directly associated with household spending on housekeeping services and on eating out. This result is particularly noteworthy in light of the fact that cleaning and cooking are the two most time-consuming routine household chores. Moreover, Cohen showed that the association of housekeeping expenses with women's earnings was nearly twice as large as their association with husbands' earnings. Oropesa (1993) also reported a link, for women employed full time, between their own earnings and the likelihood of paying someone to clean the home; there was no association, however, between their own earnings and expenditures on substitutes for cooking. And Soberon-Ferrer and Dardis (1991) found that women's wage rates, but not men's, were positively associated with spending on housework substitutes.

This research on gender differences in spending suggests that married women's housework time is affected differently by their own earnings compared to their husbands' earnings. However, to date few studies have examined the link between women's absolute earnings and their housework time. Among the exceptions are early studies by Maret and Finlay (1984) and Ross (1987), who found that women's wages had an independent and negative effect on their housework responsibilities, but did not determine the actual associations between earnings and housework. A subsequent study by Shelton and John (1993) found that the effect of women's own earnings on their housework hours was ten times greater than that of their

partners' earnings. However, their focus was on housework differences between married and cohabiting women, and they did not pursue the implications of their finding for the bargaining and gender display theories of housework. Finally, Gupta (2005) showed that the association between women's housework time and their own earnings was much larger than its relationship with their partners' earnings. However, the study did not explicitly test its hypothesis against the exchange and display models.

The second major problem with some of these earlier studies is that they have made inferences from parametric estimation on regions of low data density. In particular, very high female shares of earnings and even high female earnings are relatively rare, as are very low male shares of total earnings. Previous efforts have estimated variants of the polynomial specification in Equation (1) and interpreted turns in the estimated curves, even when the turns occur in these areas of sparse data. Parametric regression plots drawn through these data have over-interpreted the influence of these sparse data. Gupta (1999) showed that Brines' (1994) finding of gender display for men was driven by a small number of men with very low earnings shares. The same may be true of Akerlof and Kranton's (2000) conclusion that men with unusually low shares of total earnings and employment hours spend less time on housework than would be predicted by the economic exchange model. There are relatively few such men.

[Table 1 about here]

NONPARAMETRIC MODEL OF RELATIONSHIP BETWEEN EARNINGS AND HOUSEWORK

We address these problems with the existing research with a nonparametric model of the relationship between women's and men's earnings and their time spent on housework. Unlike the exchange and display models, our model does not impose a linear, quadratic or other polynomial form on the association between earnings share and housework hours. Rather, it reveals the

empirical relationships among earnings, earnings share, and housework as they actually exist in the data. This flexibility in functional form is the main advantage of nonparametric estimation. The estimated regression function is not forced to follow a curve whose shape is pre-determined by the polynomial chosen to represent the relationship between the dependent and independent variables. One of the disadvantages of nonparametric estimation, however, is that it does not produce parameter estimates that can be subjected to standard inferential tests. We therefore report our results exclusively in figures. We also compare these nonparametric results from those of conventional parametric models.

The second advantage of our method is that it does not accord undue influence to regions of sparse data. We specifically address data density both by presenting nonparametric density plots and bootstrapped estimates of the standard error of our estimates. Nonparametric density estimates are analogous to histograms, which report the fraction of the data that appear in various combinations of the joint distribution of the data. However, kernel nonparametric density estimates smooth the density and avoid the variation due to the arbitrary choice of bin starting points in conventional histograms. Observations in the neighborhood of the estimate are weighted more heavily than distant observations. Nonparametric regression averages observations of the outcome variable in the neighborhood of specified values of the explanatory variables. Again, kernel nonparametric regression estimates weight and smooths the data so that the neighborhood includes and gives more weight to observations with explanatory variables close in value to the specified values and less weight to distant observations.

For example, to compute the nonparametric density of couples in which the man earns \$25,000 and the woman earns \$15,000, we want to give much weight to couples in which the man earns exactly \$25,000 and the woman exactly \$15,000, substantial weight to couples in the bivariate neighborhood of $(\$25,000, \$15,000)$, say, in which the man earns between \$22,000 and

\$28,000 and the woman earns between \$14,000 and \$16,000, and virtually no weight to couples far outside the neighborhood, in which, say, the man earns more than \$35,000 and the woman earns more than \$30,000. The first two types of couple are close to the point of interest (man's earnings of \$25,000, woman's earnings of \$15,000), while the last couple is far.

Similarly, to compute the nonparametric regression estimate of women's housework for this couple, we would compute a weighted average of women's housework, giving substantial weight to the housework of women in couples in which the man earns between \$22,000 and \$28,000 and the woman earns between \$14,000 and \$16,000, and virtually no weight to couples in which the man earns more than \$35,000 and the woman earns more than \$30,000. Again, the former type of couple is near the point of interest (man's earnings of \$25,000, woman's earnings of \$15,000), while the latter couple is distant. These procedures are then repeated for enough points of interest to produce attractive density or regression surfaces. In our case, we carry out the estimation for 400 points in a 20-by-20 grid covering earnings from zero to \$60,000 for men and zero to \$40,000 for women.

A key decision in nonparametric density or regression estimates is the choice of bandwidth, or the width of the moving window of values of the independent variable. This width determines which observations are considered "nearby" for the purpose of computing densities or average outcomes. We use a method proposed by Bowman and Azzalini (1997) that uses the variance in both men's and women's earnings to identify a bandwidth of \$3,100 as optimal, but a range of bandwidths yielded similar results. Also, because nonparametric results are not sensitive to the choice of kernel, we use a normal kernel.

Further, rather than report parametric estimates of the standard error of nonparametric results, we bootstrap the data to produce confidence intervals. That is, we repeatedly sample our data, with replacement, to generate re-samples with the same number of observations as the

original sample, and we then repeat the estimation on each re-sample. Thus, each repetition represents an outcome from a different sample as if we had sampled repeatedly from the underlying population. We use 100 bootstrap replications to suggest 98 percent confidence intervals, with the extreme high and extreme low estimates corresponding to estimates that might occur in two of one hundred, or 2 percent, of samples, although slight trimming readily indicates 95 percent confidence intervals. The advantages of bootstrapping are its reduced reliance on large-sample asymptotic properties of estimators, the intuitive appeal of confidence intervals representing results from repeated samples, and the ease of illustrating wider intervals in less dense regions of the data.

Data

We use data obtained from the second wave of the National Survey of Families and Households (NSFH), which employed a national probability sample of housing units; one adult per household was randomly selected as the main respondent (Sweet, Bumpass and Call 1988). Members of racial and ethnic minorities were oversampled, as were single-parent families, cohabiting couples, and members of some other types of family. The survey was initiated in 1987; the second wave used in the present study was conducted in the period 1992-94.¹ The first wave of the survey obtained data on 13,007 respondents, and the second wave retained 10,005 of these original respondents. Our sample is limited to 2,226 married and unmarried heterosexual couples where both partners were between the ages of 18 and 65. (Omitting the small percentage of unmarried individuals makes no substantive difference to our findings.) The unit of observation is the couple, and each observation includes variables pertaining to both the man and the woman in the couple. Following the convention in the quantitative housework literature, the dependent variable measures weekly hours spent on four tasks: cleaning, doing dishes, cooking, and laundry.² The intention is to capture routine, daily housework rather than occasional

housework, such as yard work or repairs. Time spent on childcare is not included in the measure because it was not explicitly surveyed. For each member of the couple, the earnings variable reports annual labor earnings.

Although the estimation method is robust to low data density, we focus attention on regions of joint earnings that include the vast majority of couples. To avoid large gaps in our plots between the few points with unusually high earnings and the rest of the data, we excluded 216 couples in which the man's earnings exceeded \$60,000 per year or the woman's earnings exceeded \$40,000, which yielded a final sample of 2,010 couples. (Including these couples makes no difference to our findings.) Further, to eliminate the influence of partners' employment hours on our results, we present another set of results for couples in which both partners worked at least 30 hours per week outside the home. We further restrict this sub-sample to couples in which each partner earned at least \$10,000; this full-time sample consists of 665 couples. Means and standard deviations for the independent and dependent variables are shown in Table 2.

[Table 2 about here]

RESULTS

Figure 1a presents the nonparametric estimate of the joint density of both partners' earnings. The two horizontal axes represent man's earnings and woman's earnings, and the height indicates the density or relative abundance of couples for each combination of joint earnings. The ridge along the man's earnings ("his.earnings") axis, at zero earnings for the woman, shows a roughly unimodal distribution of earnings for men with non-working partners, with the peak at man's earnings slightly below \$40,000 and additional density at man's earnings of \$20,000. At woman's earnings of around \$20,000, there is a smaller ridge, parallel to the first, with two distinct modes in man's earnings, at \$20,000 and at slightly below \$40,000.

[Figure 1a about here]

We also present in Figure 1b a parametric version of the joint distribution of woman's earnings and man's earnings with a bivariate normal density plot, which uses only the mean and standard deviation of woman's earnings and man's earnings and the correlation between them. The advantages of the nonparametric density plot are obvious. The clusters of couple types (high-earning man, non-earning woman; low-earning man, non-earning woman; two full-time workers) are evident in the nonparametric plot and disappear entirely when the unimodal bivariate normal density is imposed on the data.

Figure 1a by itself suggests a shortcoming of parameterized approaches to the earnings and housework question. The density of couples is quite low at the earnings combinations where some parametric studies have reported evidence of gender display, primarily in couples with high female shares of total earnings. Note also that there is low density on the far right side of the plot, which shows that there are very few couples with both high total earnings and high female share. In the relatively small number of couples in which female earnings exceeds male earnings, total earnings tend to be low. This is represented by the small ridge along the "her.earnings" axis at male earnings of zero. Parametric estimates on the basis of Equation (1), such as the gender display model, extrapolate trends from the high-density regions and erroneously make predictions about couples of particular interest in low-density regions. While there are parametric approaches that could address this problem, for example parametric error bands around the sample prediction in regions of special interest, no past studies have undertaken these approaches. We believe that nonparametric regression offers a more direct interpretation of couples' behavior.

Figure 2a presents the central nonparametric regression result. The bandwidth used to generate this figure is \$4,100; it is different from the \$3,100 bandwidth used in Figure 1a because it is based on the variance of the outcome variable. The two horizontal axes again

represent men's earnings and women's earnings. The vertical axis presents women's average housework time for each combination of joint earnings. For example, in a couple with the man earning \$40,000 and the woman earning zero (marked by a circle in the upper left of the plot), predicted housework for the woman approaches 35 hours per week. The predicted housework for a woman earning \$20,000 with the man earning \$40,000 (marked by the lower circle) is a substantially lower 25 hours per week. Predicted housework for women clearly decreases with their earnings, for all levels of men's earnings. That is, the regression surface slopes consistently downward from front-left to rear-right. This relationship is especially and smoothly visible in the regions of highest density described in Figure 1a. While additional earnings are associated with reduced housework for the woman, we note that the range of predicted housework is limited. A large increase in the woman's earnings from zero to \$35,000 is associated with a one-third reduction in her housework hours, from a little over 30 hours per week to slightly below 20 hours per week, regardless of the man's earnings.

[Figure 2a about here]

Note also that predicted housework for women has no discernible relationship to men's earnings. The regression surface is remarkably flat from front-right to rear-left. Again, the estimated relationship is especially smooth and flat in the high-density regions of the surface (men's earnings between \$20,000 and \$40,000 and women's earnings between zero and \$20,000). Even a very large increase in men's earnings implies no change in predicted housework, and the level of predicted housework depends most directly on women's earnings. These findings immediately call into question the validity of conventional models based on relative earnings: if only women's own earnings matter to their housework, there is no justification for employing their earnings compared to their male partners' as a predictor.

We also estimate equation (1) by ordinary least squares and include only total earnings among the other regressors Z_i . The parametrically estimated surface, shown in Figure 2b, looks substantially smoother and more regular than the non-parametric surface in Figure 1a. In particular, it is not clear what portion of the data drives the behavior of the parametric plot, in particular at the edges of the plot. On the one hand, the behavior at the edges has the possibility of being influenced by leverage points; on the other hand, the behavior of the edges may represent almost out-of-sample extrapolation of a naïve functional form imposed on the bulk of the data where the data are dense. With parametric estimation, it is simply hard to tell.

Figure 3 presents men's average housework time as the outcome on the vertical axis, and these results confirm that the overall level of average housework for men is quite low. The level of the regression surface is substantially below 10 hours in the regions of highest density. The maximum, which occurs in the region with low-earning men and high-earning women, is still below 15 hours per week. Referring to Figure 1a, we note that this estimate is based on very low density of couples in the relevant region. Men's housework shows a slight downward slope as men's earnings increase (from front-right to rear-left) and a slight upward slope as women's earnings increase (from front-left to rear-right). Figures 3 and 2a have the same vertical and horizontal scales, making it easy to see that men's housework is substantially less responsive to changes in women's earnings than is women's own housework.

[Figure 3 about here]

In Figure 4, we highlight the response of housework to earnings for dual-earner couples in which both partners work full time. The figure shows the nonparametric regression estimates for a sample limited to households in which both partners work at least 30 hours per week and each partner's earnings exceeds \$10,000 per year to exclude households with reporting errors or exclusively seasonal work. Because the estimates are local, or based on observations in the same

region, Figure 4 is essentially nested in Figure 2a, and the estimation on the sub-sample is not substantively different but permits the reader to focus on dual-earner couples. We note in Figure 4 the absence of slope in the dimension of men's earnings, the same pattern that appears in the full sample, Figure 2a. The downward slope in the direction of increased women's earnings is also similar to that in the full-sample case. Figure 4 indicates again that women's earnings are by far the stronger correlate of women's housework.

[Figure 4 about here]

In Figures 5a and 6a, we take slices of the regression surface from Figure 2a. The estimation method is identical, but the presentation, as a set of nonparametrically estimated curves rather than as a single surface, permits direct assessment of the alternative parametric approaches. In Figure 5a, we hold constant the woman's share of earnings, first at one-third (solid black line), then at one-half (dashed black line), and finally at two-thirds (dotted black line) of household earnings. Within each value of constant share of household earnings, we then vary the total amount of women's earnings. The estimation is equivalent both to varying the total amount of household earnings with a constant share for each partner and to plotting the intersection of the regression surface and a vertical plane through the origin along rays with slopes of $1/2$, 1 , and $2/3$ in the horizontal plane. The most striking feature of Figure 5a is the similarity in the level and response to earnings of women's housework by women's earnings, regardless of the earnings share. If the woman's earnings are between \$5,000 and \$10,000, then the predicted housework is between 26 and 28 hours per week. As her earnings increase, e.g., to \$20,000, predicted housework falls to between 20 and 22 hours per week. Men's earnings, or equivalently couples' earnings after controlling for women's earnings, explain virtually no variation in women's housework.

[Figure 5a about here]

Figure 5a also shows significant linearity in the relationship between women's earnings and women's housework over the domain from \$5,000 to \$20,000 per year in women's earnings. In lieu of computing parametric standard errors for the estimate of the relationship, we use a bootstrap approach. The web of gray lines around each black line shows the results of 20 replications on bootstrapped samples with the solid, dashed, and dotted scheme corresponding to the respective estimates. From \$5,000 to \$20,000 in women's earnings, the bootstrapped estimates are quite close to the main estimate and confirm the linearity of the relationship. Above \$20,000 in women's earnings, the bootstrapped estimates spread substantially around the main estimate. Figure 5a thus demonstrates the danger of drawing conclusions about low-density regions from parametric models. Although the main regression line flattens out at women's earnings of approximately \$20,000, which suggests a convex relationship, we argue that the conclusion of a convex relationship is erroneously based on estimates from a low-density region of the sample (Figure 1a). The spread of the bootstrap estimates at women's earnings above \$20,000 shows that rather than being nonlinear, the estimates in this region are unreliable.

In Figure 6a, we hold the women's earnings constant and then vary the share of household earnings represented by women's earnings, which is equivalent to varying men's earnings with women's earnings constant. The solid line corresponds to women's earnings of \$30,000, the dashed to \$20,000, and the dotted to \$10,000. The distinct level of the three lines is equivalent to the finding that women's housework responds to women's earnings as reported in Figures 2a and 4a. The overall flatness of all three lines in Figure 6a shows that after controlling for women's earnings, there is little response of women's housework to women's share. The hints of interesting relationships in the three curves in Figure 6a can be attributed exclusively to sampling variation, as the bootstrapped curves in gray around each regression curve indicate. If we are willing to indulge in some speculation nonetheless, then the slight upward grade in

housework as the women's share increases from 0.35 to 0.55 for women earning \$20,000 or from 0.20 to 0.45 for women earning \$10,000, could provide weak support for a gender display model. In any case, the relationship is quite weak, with rises of less than two hours per week associated with substantial differences in share of earnings.

[Figure 6a about here]

The weaknesses of the parametric approach become evident when we reproduce the results of Figures 5a and 6a parametrically; the results are shown in Figures 5b and 6b. The error bands here are produced with the same bootstrapping technique. In both cases, the parametric plots erroneously suggest interesting relationships that disappear in the nonparametric approach. For example, in Figure 5b, the parametric approach suggests different slopes of housework versus share at different levels of women's earnings. Indeed, the relationship appears to be downward-sloping for low-earning women but upward-sloping in the case of high-earning women. Such a finding might imply support for the gender display hypothesis—high-earning women have to compensate their partners for the loss of masculinity, especially if the woman has a high share of earnings. Yet the nonparametric approach demonstrates that this relationship (Figure 5b) is merely a figment of parametric estimation; it is based on very sparse data.

[Figures 5b and 6b about here]

DISCUSSION

Our analysis demonstrates that women's share of couples' earnings has very little explanatory value when it comes to their housework time. Their housework hours remain flat as their relative earnings change and are unresponsive to their male partners' earnings, but decline with their absolute earnings at various levels of relative earnings. This is the case even among dual-earner couples in which both partners worked full time. The same finding obtains in a full-fledged

parametric model of women's housework with all the customary controls, such as employment hours, age, education, and number of children (results available from the authors).

These results constitute a prima facie case against the exchange and display models, and lend support to our proposed alternative that emphasizes the importance of women's own earnings as a determinant of their housework hours.

Our nonparametric models address two problems with earlier research. First, simply controlling for family earnings in an earnings share model, as earlier studies have done, does not address whether the relationship between earnings share and housework varies by the level of earnings. The nonparametric approach allows the relationships among earnings, earnings share, and housework hours to emerge from the data. It does not rely on the specification of a linear or parametrically curvilinear relationship between earnings share and time spent on housework, as did earlier studies based on the exchange and display hypotheses. The nonparametric density plots show that the relationship that actually exists in the data is not between women's share of earnings and their housework time, but between their own earnings and housework. That is confirmed by the nonparametric regression results with bootstrapped confidence intervals shown in Figures 4 and 5.

Second, our results account explicitly for changes in data density across the joint distribution of earnings and housework. Where the data are thin, the confidence bands from the bootstrap re-samples are relatively distant from the central estimate. In contrast to some previous studies, which have presented single inferences for the entire range of the earnings distribution, these figures indicate regions where such inferences may not be reliable. We directly compare our nonparametric results with a conventional parametric estimation and find substantial evidence that parametrization can generate a spurious empirical finding in support of one of the competing hypotheses.

The results presented here are open to multiple interpretations. The simplest is that women defray their housework time by using their earnings to purchase market substitutes, or services, for domestic labor. This possibility is consistent with earlier research showing a link between women's earnings and intrahousehold resource allocation, which has documented gender differences in household expenditures related to women's responsibilities, such as domestic labor and child care. Unfortunately, we cannot perform a direct test of this hypothesis because the NSFH, like other datasets used frequently in the housework literature, does not have detailed data on household expenses. And the datasets employed in the research on household expenditures have expense data but lack time use information. A complete analysis of the links among earnings, time use, and expenses will have to await a dataset with quality measures of all three variables.

If women do use their earnings to reduce their housework time independently of their male partners' earnings, the strategy may ease the friction associated with negotiations over the allocation of domestic labor documented in the classic study by Hochschild and Machung (1989). In this way it may be complementary, or provide an alternative, to the kind of bargaining implicit in the economic exchange model. It could also be the case that women feel freer to buy out their housework if they themselves earn more. Another possibility is that couples segregate their expenses by type and delegate responsibility for different types of expense separately to each partner, so that women's own earnings have a larger impact on housework-related expenditures than do their male partners'. A satisfactory resolution of these issues would require detailed data not only on earnings, expenses, and time use, but also on couples' financial arrangements. No such data exist; their availability would facilitate our understanding of key processes and outcomes in heterosexual couple households.

TABLE 1: Evidence for the economic exchange (or relative resources) and gender display (or deviance neutralization) perspectives in recent research using relative earnings as predictor of housework hours^a

Study	Women	Men	Data
Akerlof and Kranton (2000)	Not explicit	US: display	Panel Study of Income Dynamics, 1983-92 (pooled)
Bittman et al (2003)	US: exchange Australia: both	US: display Australia: neither	National Survey of Families and Households, 1987-88 Australian Time-Use Survey, 1992
Brines (1994)	US: exchange	US: display	Panel Study of Income Dynamics, 1985
Evertsson and Neramo (2004)	US: neither US: display US: display Sweden: exchange	US: display US: exchange US: neither Sweden: exchange	Panel Study of Income Dynamics, 1973 Panel Study of Income Dynamics, 1981, 1991 Panel Study of Income Dynamics, 1999 Swedish Level of Living Survey, 1974, 1981, 1991, 2000
Greenstein (2000)	US: display	US: display	National Survey of Families and Households, 1987-88

^a The dependent variable in the studies by Bittman, Brines, and Evertsson and Neramo is absolute housework hours. Greenstein uses both absolute and share measures of housework hours; the table entry is based on the results for the distributional measure.

TABLE 2: Summary Statistics (N = 2,010)

Variable	Mean	S.D.	Min	Max
Woman's housework hours	25.7	14.4	0.0	67.0
Man's housework hours	8.9	6.8	0.0	31.3
Woman's annual earnings (\$ thousands)	11.6	10.4	0.0	39.8
Man's annual earnings (\$ thousands)	24.2	14.2	0.0	59.6
Woman's share of total earnings	0.3	0.3	0.0	1.0

FIGURE 1a: Nonparametric joint density plot of male and female partner's annual earnings

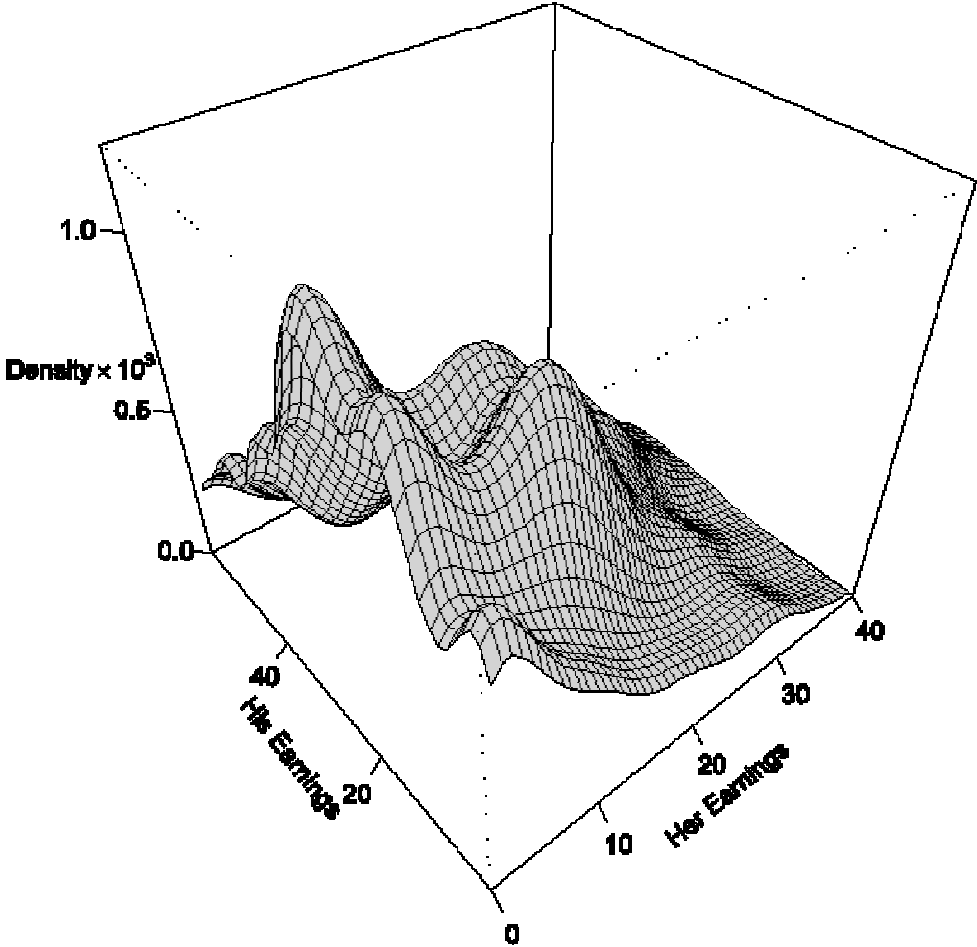


FIGURE 1b: Parametric joint density plot of male and female partner's annual earnings

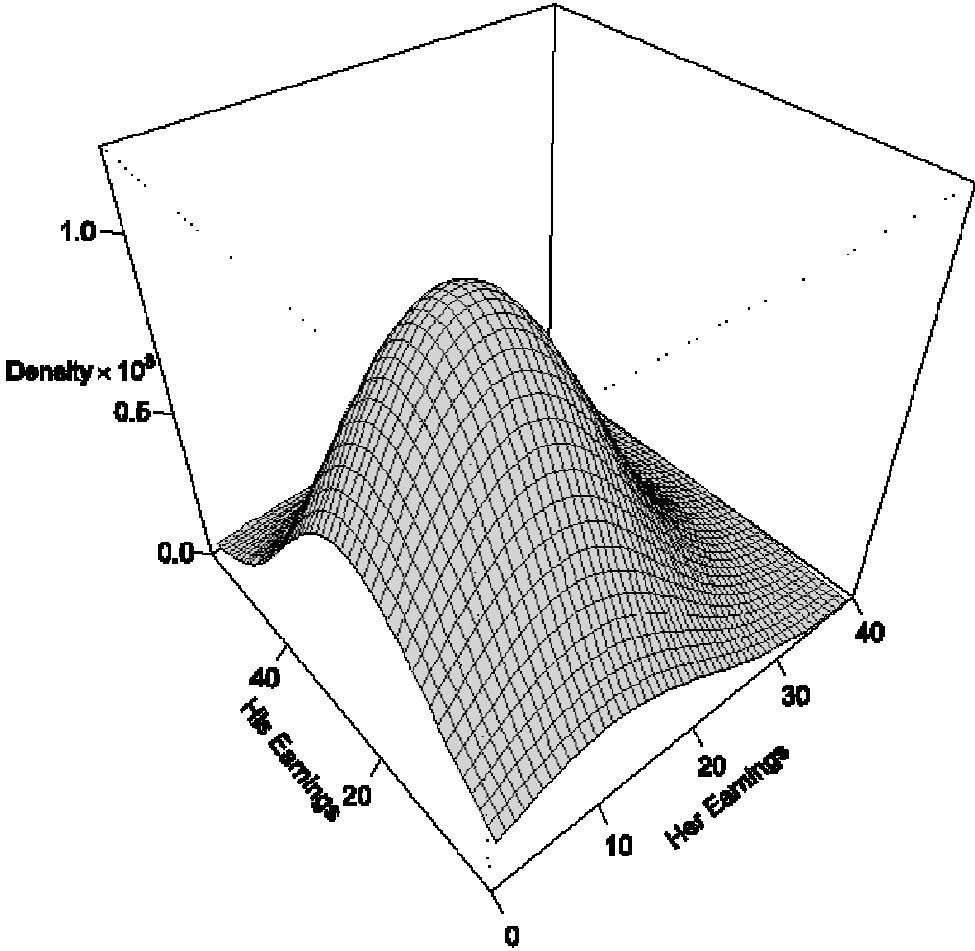


FIGURE 2a: Nonparametric results for woman's housework hours as a function of woman's and man's annual earnings

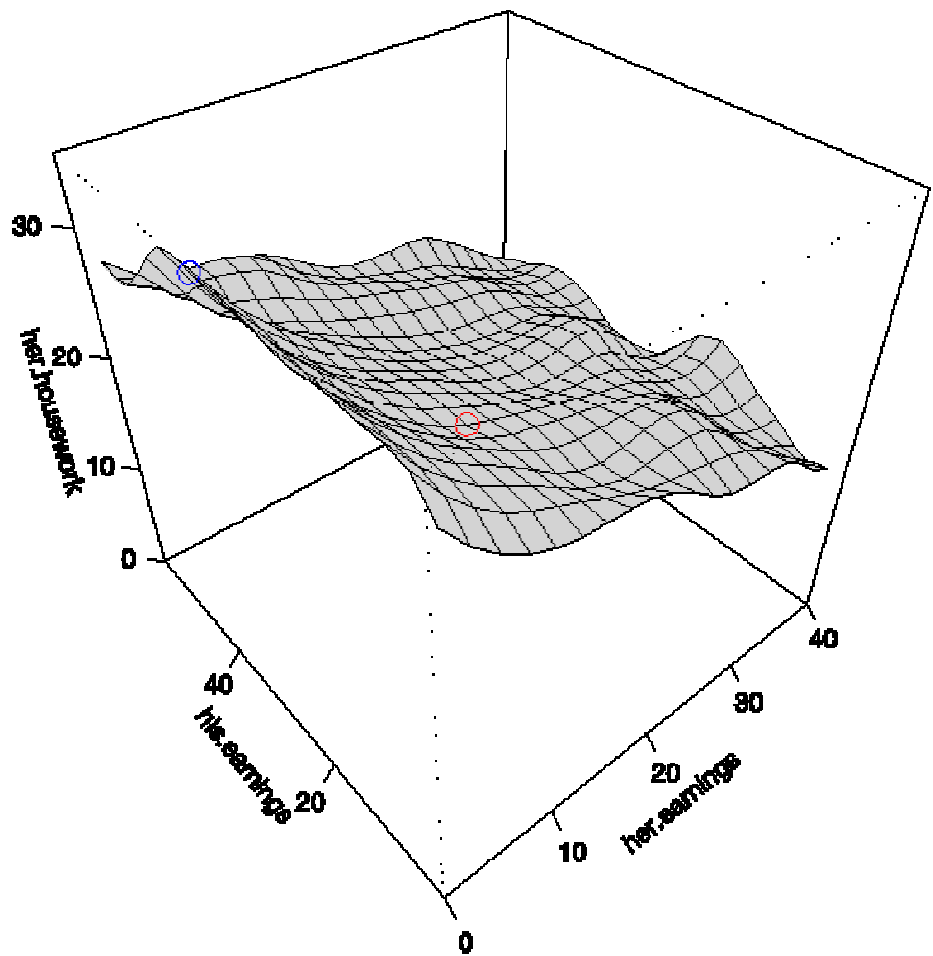


FIGURE 2b: Parametric (OLS) results for woman's housework hours as a function of woman's and man's annual earnings

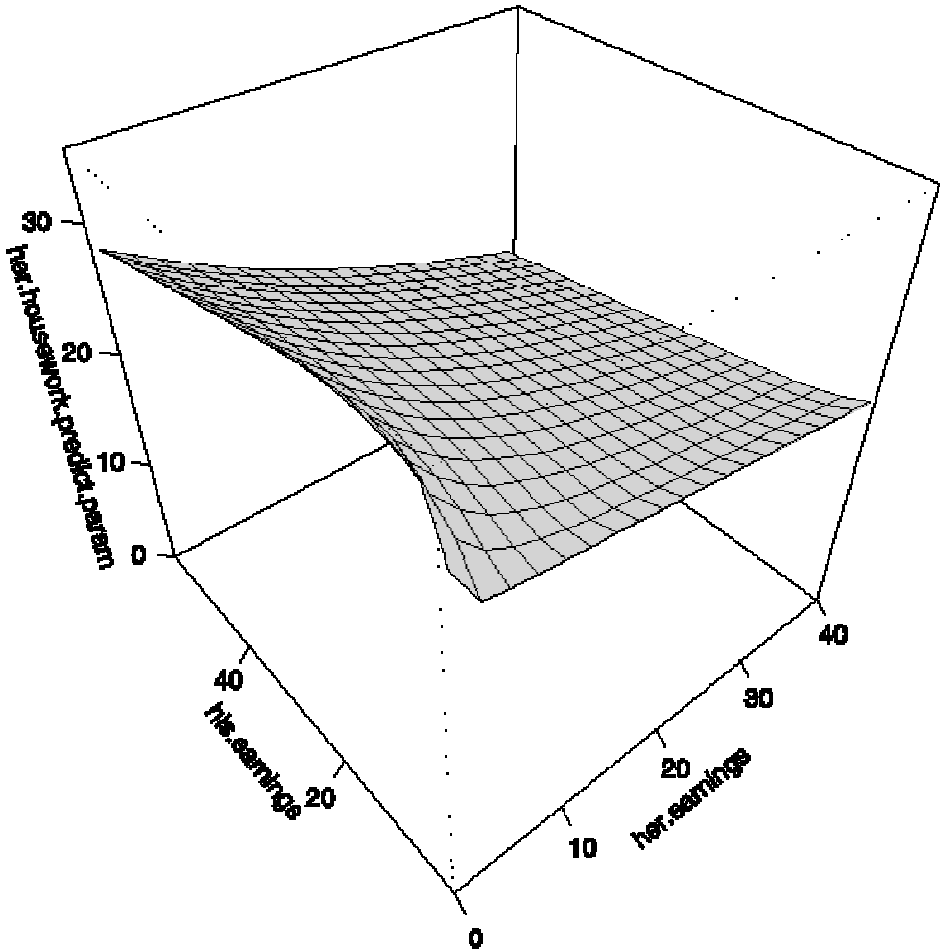


FIGURE 3: Man's housework hours as a function of woman's and man's annual earnings

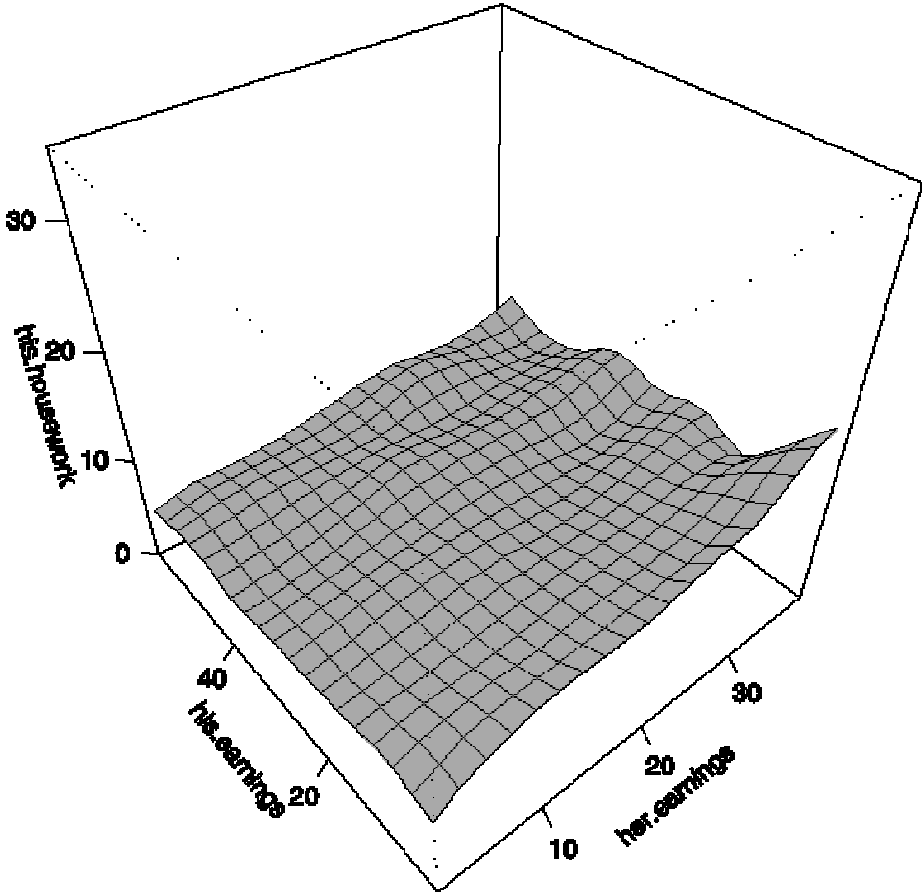


FIGURE 4: Woman's housework hours as a function of woman's and man's annual earnings, both partners working at least 30 hours per week and earning at least \$10,000 annually

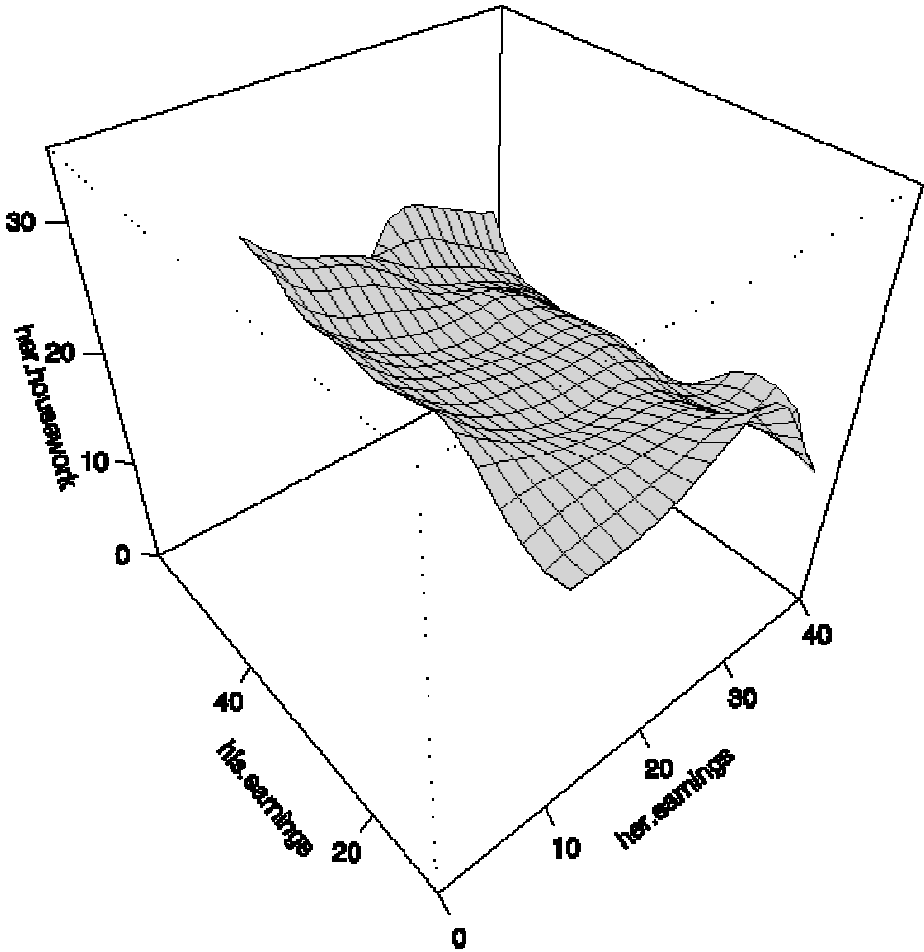


FIGURE 5a: Nonparametric results for woman's housework hours as a function of woman's annual earnings, holding woman's earnings share constant

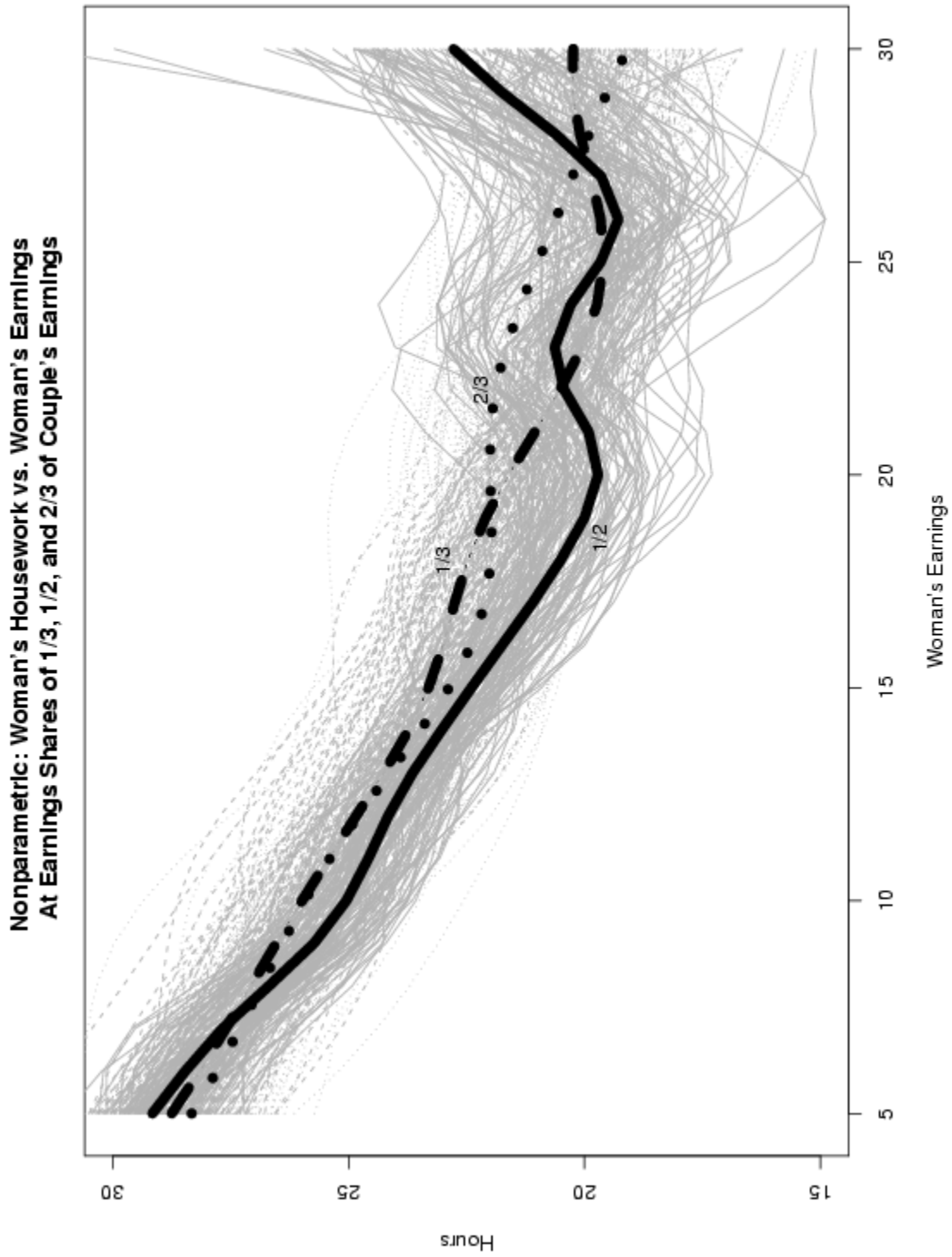


FIGURE 5b: Parametric results for woman's housework hours as a function of woman's annual earnings, holding woman's earnings share constant

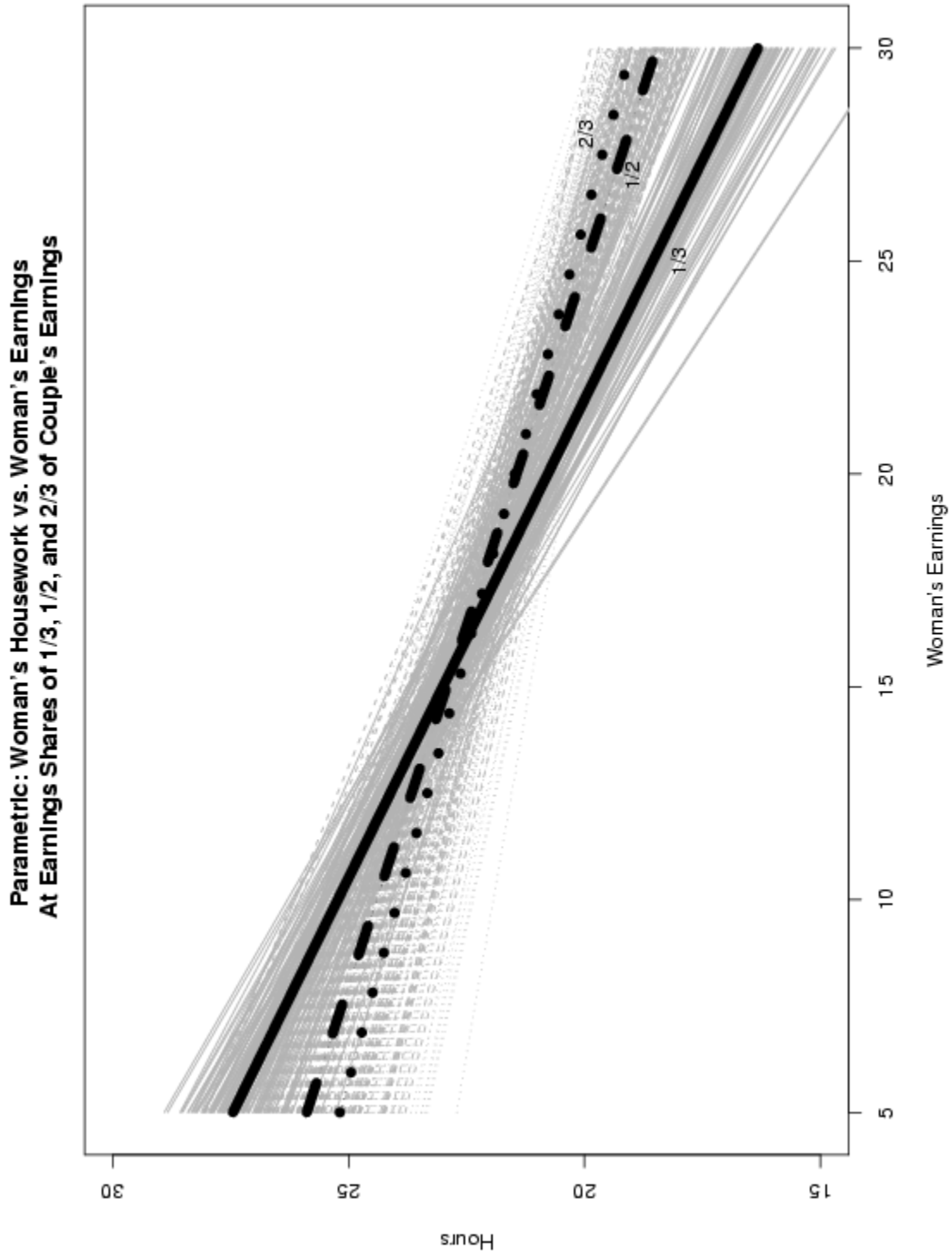


FIGURE 6a: Nonparametric results for woman's housework hours as a function of woman's share of couple's total earnings, holding woman's annual earnings constant

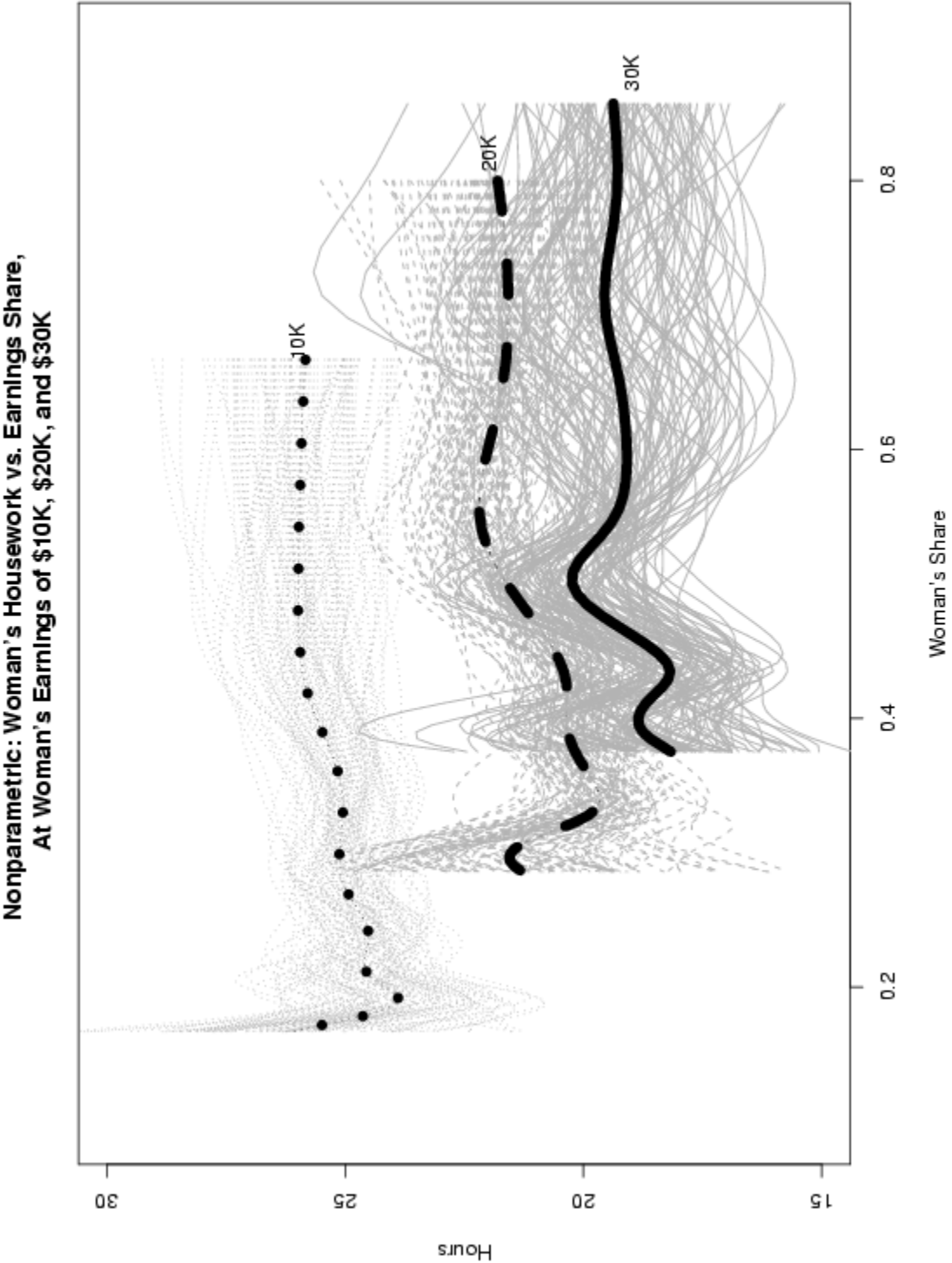
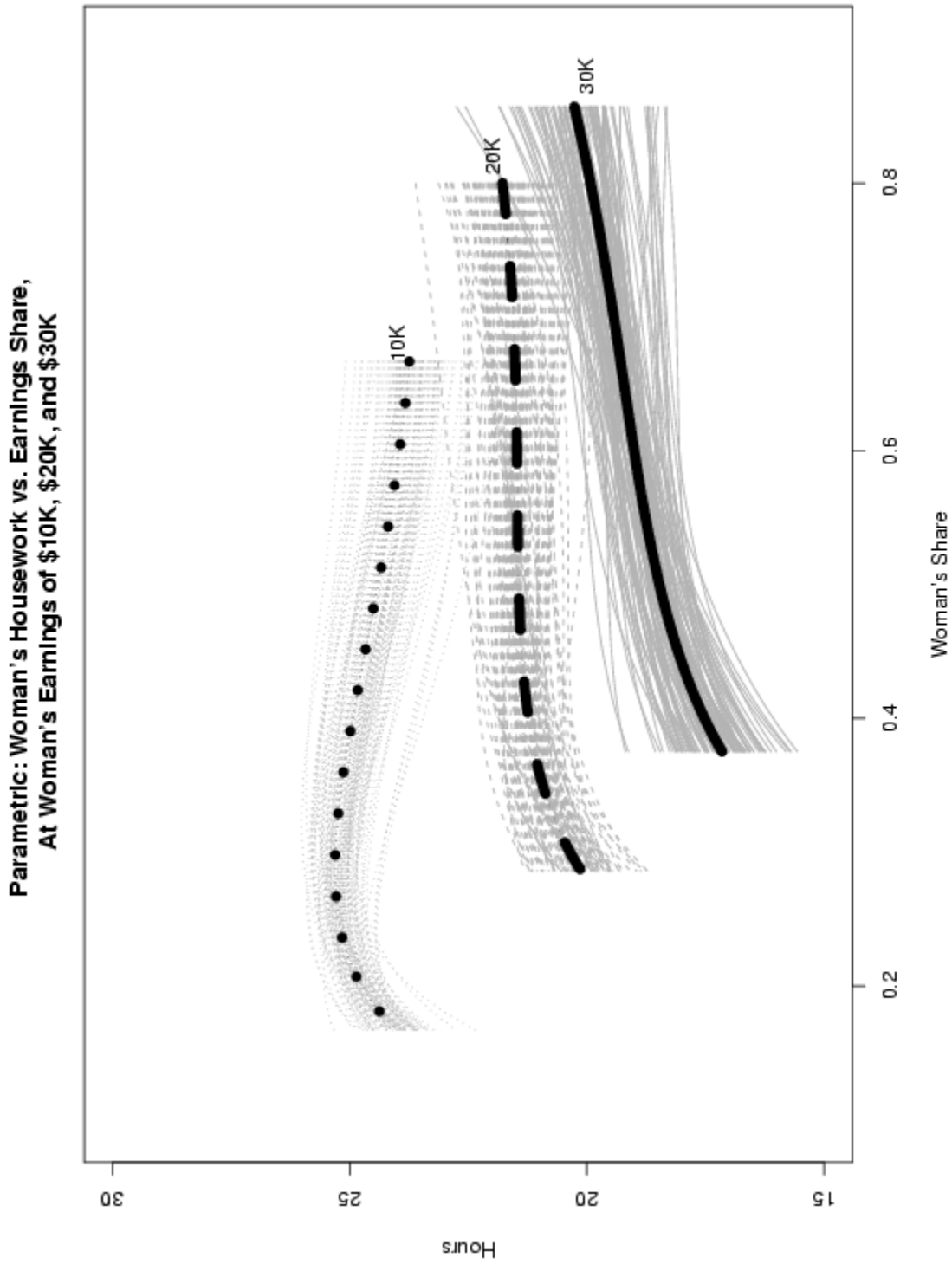


FIGURE 6b: Parametric results for woman's housework hours as a function of woman's share of couple's total earnings, holding woman's annual earnings constant



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FOOTNOTES

1. A third wave became available recently, but it followed up a restricted subset of the sample from the first two waves. (See the NSFH website, <http://www.ssc.wisc.edu/nsfh/home.htm>, for a complete description of the three waves.) Accordingly we use the second wave, which has already been extensively used in the housework literature, and which has data on a larger sample than the third.
2. To account for the implausibly high values for housework hours reported by some respondents, we adopt a procedure used by South and Spitze (1994). Values higher than the 95th percentile are recoded to that percentile for each of the four chores before summing them to obtain the dependent variable. To maximize the number of usable cases, the mean number of hours for each task is imputed for men who do not specify or do not know how many hours they spend on that task. Also, zeros are substituted for men who do not answer the survey question for a particular task but report hours for at least five other tasks.