PRELIMINARY AND INCOMPLETE: PLEASE DO NOT CIRCULATE

Taxes and Time Allocation: Evidence from Single Women*

Alexander M. Gelber
University of Pennsylvania and NBER

Joshua W. Mitchell
Harvard University

October 2009

Abstract

Hundreds of papers have investigated how incentives and policies affect hours worked in the market. This paper examines how income taxes affect time allocation in the other two-thirds of the day. Using the Panel Study of Income Dynamics from 1975 to 2004, we analyze the response of single women's housework, labor supply, and other time to variation in tax and transfer schedules across income levels, number of children, states, and time. We find that when the economic reward to participating in the labor force increases, hours worked increase and housework decreases, with the decrease in housework accounting for roughly three-quarters of the increase in market work. Analysis of repeated cross-sections of time diary data from 1975 to 2004 shows similar results, with various measures of "home production" accounting for at least half of the increase in market hours of work in response to policy changes. Data on expenditures from the Consumer Expenditure Survey from 1980-2003 show some evidence that expenditures on market goods likely to substitute for housework increase in response to an increased incentive to join the labor force. The results are consistent with the classic time allocation model of Becker (1965).

* We thank Raj Chetty, David Cutler, Lawrence Katz, Claudia Olivetti, Dan Sacks, Todd Sinai, Justin Wolfers, and numerous seminar participants for suggestions. We are grateful to Adam Looney, Bruce Meyer, and Mel Stephens for generously sharing data. We are also grateful to Mark Aguiar and Erik Hurst for making their data and code available on the web. Dan Sacks provided outstanding research assistance. Gelber acknowledges financial support from the National Institute on Aging, Grant Number T32-AG00186. All errors are our own. Email: agelber@nber.org.

Hundreds of papers have investigated how incentives and policies affect hours worked. This paper examines how income taxes affect time allocation in the other two-thirds of the day, as well as market work.

This issue is important from several perspectives, both normative and positive. Over the past thirty years, policy-makers sought to reduce dependency and increase the labor force participation of single mothers by expanding the Earned Income Tax Credit (EITC) and reforming the welfare system. One key motivation for reform was the perception that some single mothers were choosing to be idle and ought instead to contribute more productively to society. Phrased in efficiency terms, single mothers' leisure is considered by some to be the opposite of a "merit good," in the sense that it may be considered "intrinsically bad." It is now well documented that these reforms did indeed significantly increase single mothers' labor force participation (Eissa and Liebman 1996; Meyer and Rosenbaum 2001). Less understood is where this increase in market time came from. In this paper we assess whether policy reforms induced single mothers to reduce leisure or to instead shift from one productive activity—work at home—to another—work in the market. In a 2-sector general equilibrium model of employment and capital in the home and market sectors, the response of home work to taxation is also an important determinant of deadweight cost of taxation (Boskin 1975).

From a positive standpoint, these issues are relevant to several areas of inquiry. Understanding the time allocation decisions of individuals is a core area of interest within labor economics. We interpret our results within the canonical model of time use of Becker (1965). In this framework individuals derive utility from consumption of "commodities," each of which is produced using both a time input and a market good input. The model predicts that as the wage rises, individuals' expenditures on market goods rise relative to their time inputs. Using exogenous policy variation allows us to test this theory. The substitutability of market goods and home time is also a crucial issue in much of the macroeconomics literature (Benhabib, Rogerson, and Wright 1991; Greenwood, Seshadri, and Yorukoglu 2005).

Using the Panel Study of Income Dynamics from 1975-2004, we find that among single women, labor force participation rises significantly when the fraction of their earnings taken away in taxes falls, with a baseline elasticity of .43. This is consistent with findings in previous literature (Eissa and Liebman 1996; Meyer and Rosenbaum 2001). The baseline specification shows that when hours worked rise by 1 hour in response to lower taxes, time spent on housework falls by about 45 minutes. The finding that market work rises substantially and housework falls substantially in response to decreased taxation of labor earnings is robust to a wide variety of specification checks, including instrumenting for one measure of the net-of-tax rate with another; instrumenting for the net-of-tax wage with the net-of-tax rate; correcting for self-selection into the labor force; incorporating transfer programs into the measure of incentives; instrumenting for non-labor income with welfare benefits; addressing the potential endogeneity of the number of children; examining whether the extensive margin of labor supply is the primary margin of adjustment; controlling for macroeconomic conditions, income group trends, age of kids, education-by-year fixed effects; and adding number of number-of-child-by-year, state-by-year, and state-by-number-of-child fixed effects.

We supplement our examination of the PSID with an analysis of two additional datasets. The repeated cross sections on time use assembled by Aguiar and Hurst (2007) allow us to disaggregate time use into detailed categories. This analysis also shows that an increased net-of-tax share causes a substantial and significant increase in market hours worked and a decrease in housework.[1] We investigate a variety of definitions of (what Aguiar and Hurst refer to as) "home production" and "leisure" and find consistent evidence that the increases in market work corresponds to substantial and significant decreases in home production or non-market work. We also find some evidence that leisure decreases. We investigate a number of other disaggregated outcomes of interest. These include time spent eating and preparing food, which decreases, and time spent sleeping—a hallmark of "idleness"—which changes insignificantly.

[1] Meyer and Sullivan (2004, 2008) are two important papers examining time use and expenditures before and after policy reforms. Our results complement their findings.

Analysis of the Consumer Expenditure Survey allows us to investigate how these changes in work in the market and the house interact with consumption patterns. We find evidence that expenditures on food prepared away from home—which could substitute for time spent on food preparation and eating—increase in response to an increase in the incentive to participate in the labor force. We find that overall food expenditures change insignificantly. In combination with the finding that time spent eating and preparing food falls, we interpret this pattern of results as evidence consistent with the Becker model.

Section 1 briefly reviews some of the major changes in tax policy over the time period in question, focusing on those that had a particularly large impact on single women. Section 2 describes the data. Section 3 discusses our empirical specifications. Section 4 turns to the results from the PSID. Section 5 contains the results from the repeated cross-sections on time use. Section 6 describes results from the CEX. Section 7 concludes.

1. Policy Environment

The period under consideration contained major changes in tax and transfer policy.[2] A series of tax acts, passed in 1981, 1986, 1990, 1993, 2001 and 2003, dramatically changed the federal income tax code. We review the policies that affected single women the most. Among low-income taxpayers, the primary changes came from large expansions of the Earned Income Tax Credit (EITC), which implied an increasing incentive for labor force participation.

The size of the EITC, which is a refundable tax credit, depends on earned income and the number of qualifying children. The EITC tax schedule has three regions. Over the "phase-in" range, a percentage of earnings is transferred to individuals. Over the "plateau" region, an individual receives the maximum credit, after which the credit is phased out (currently at a rate of 21.06%).

[2] See Blank (2002), Hotz and Scholz (2003), Moffitt (2002), Moffitt (2003) and Eissa and Hoynes (2005) for reviews of the literature on welfare and the Earned Income Tax Credit.

A small EITC was first introduced in 1975. The EITC was expanded substantially in the tax acts of 1986, 1990, and 1993. The 1986 expansion of the EITC increased the phase-in rate and region. These changes were reinforced by increases in the standard deduction and the dependent exemption to reduce income tax liabilities for tax filers at the bottom of the income distribution. The largest expansion of the EITC was in 1993. This reform increased the additional maximum benefit for taxpayers with two or more children, which reached $1400 in 1996. Phase-in rate for the lowest-income recipients increased from 18.5% to 34% for families with one child and from 19.5% to 40% for families with two or more children. Figure 1 summarizes important features of the changes in tax policy over this period, showing that through a series of policy changes starting in the mid-1980s, there came to be an increasing incentive to participate in the labor force for low-income single women with children relative to those without children, because the fraction of earnings a woman keeps if she participates in the labor force rose substantially for single women with children relative to those without children. The tax act of 2001 reduced the bottom tax bracket rate from 15% to 10%.

While we primarily focus on tax policy in this paper, it is worth noting the changes in welfare policy, which we sometimes include as a control variable. Prior to 1997, Aid to Families with Dependent Children (AFDC) provided cash payments primarily to single mothers with children. The Food Stamp program gives low-income households coupons to purchase food. AFDC program parameters were set by the states. Most Food Stamp parameters are the same in all states, but because eligibility for Food Stamps and AFDC interact, people in similar situations in different states may receive different Food Stamps. Both of these programs had secularly growing expenditures until 1997. The typical implicit tax rate imposed by the AFDC program was two-thirds. From 1980 through 1993, mean benefits for a working single mother remained roughly constant as implicit tax rates were reduced. Under AFDC, states could receive waivers to experiment with parameters of their welfare programs. Between January 1993 and August 1996, the federal government approved welfare waivers in 43 states. Under waiver programs, states usually made welfare eligibility criteria more stringent and reduced the generosity of welfare benefits. In 1997, the Personal Responsibility and

Work Opportunity Act replaced AFDC with Transitional Aid to Needy Families (TANF), resulting in a wide variety of changes to the welfare system, including further cuts in average welfare benefits, work requirements, and more stringent time limits.

2. Data

We use three datasets, which are described more fully in our data appendix. Our core analysis is in the Panel Study of Income Dynamics. We use data from 1976-2005 on unmarried female heads of household aged 25-55 (inclusive) who appear in at least two survey waves, excluding cohabitators.[3] We also exclude the PSID poverty sample and individuals with allocated values of any outcome variables. We follow Meyer and Rosenbaum (2001) and Eissa and Liebman (1996) in focusing on single women for a number of reasons. First, many of the policies we examine were specifically oriented toward increasing the labor force participation of single mothers, providing fruitful exogenous variation. Second, it is difficult to measure the true average tax rate for married individuals: this can be done by assuming that one spouse takes the other spouse's earnings as given in making the labor supply decision, but there is evidence that this produces substantially biased estimates of labor supply parameters (Gelber 2009). We have also run our regressions on a PSID sample of single male heads of household and find no evidence of a significant response to the policy parameters, consistent with the existing literature on the labor supply of single men that typically finds little to no labor supply response to wages or taxes.

We measure labor force participation, usual weekly hours of market and home work, earned and unearned income, and demographics. Usual weekly hours worked includes hours worked at both main and extra jobs during the previous calendar year. We construct a binary variable measuring labor force participation equal to one if the respondent has positive annual hours worked and equal to zero otherwise. As our measure of housework, we use the answer to the following question: "About how much time do you spend on housework in an average week? I mean time spent cooking, cleaning, and doing other work around the house." We use PSID data beginning in

[3] Survey years 1976-2005 contain data on activities in the previous year, i.e. data on years 1975-2004.

survey year 1976 because that is the first year this question was asked. All observations are weighted by the PSID cross-sectional weights.

The sample includes 9,242 observations, corresponding to 1,243 individuals. Summary statistics for primary variables of interest are in Table 1. It is notable that individuals in the sample work nearly a full workweek (37.50 hours) on average, unconditional on labor force participation status. 89% of the sample works a positive number of hours during the year. Figure 2 shows the trends over time in mean market work and housework among single women with and without children, using PSID data. Over the period of the primary policy changes, from the mid-1980s to the mid-1990s, mean hours worked rose markedly for single women with children relative to those without children. In other time periods, little relative change is seen over time in the two groups. The trends in housework in the two groups look almost like a mirror image of the trends in market work. Housework fell substantially for single women with children relative to those without during the period of the policy changes, and the relative change in housework in the two groups appears nearly as large as the relative change in market work.

Our more detailed time use data use come primarily from the repeated cross sections assembled by Aguiar and Hurst (2007), henceforth AH. The reader can review this paper for a detailed description of the data. AH coded time use categories as consistently as possible across years of the data.[4] We again use data from 1975-2004 and restrict the sample as close as possible to unmarried female heads of household aged 25-55 (inclusive). AH use data from 1965, 1975, 1985, 1992-4 (referred to as "1993" for concision), and 2003. We make the following changes relative to the AH data. We exclude the 1965 cross section since it is unrepresentative of the country (with no sample weights to make it representative), and since it is outside of the time frame we consider in our analysis of the PSID and CEX. For the 1993 cross-section, number of children is missing, though presence of a child is not missing. As a result, we impute it by assuming

[4] Book-length references on time use include Juster and Stafford (1985), Robinson and Godbey (1999), Becker and Ghez (1975), and Hamermesh and Pfann (2005). Ramey (2008) critiques some aspects of the AH categorization; see AH (2008) for a response.

that everyone with at least one child has exactly two children. The 2003 AH data come from the American Time Use Survey (ATUS), and we supplement the 2003 data with data from the 2004 cross-section to increase sample size and match exactly the final labor market year in the PSID.

We follow AH in defining several alternative measures of leisure and home production. Leisure 1 consists of activities broadly relating to socializing, relaxing, and enjoyment of life. Leisure 2 includes all of the activities in Leisure 1, plus eating, sleeping, and personal care. Leisure 3 includes all of the activities in Leisure 2, plus child care. AH define Home Production as preparing meals, housework, and gardening and pet care. They define Non-Market Work as Home Production plus time spent obtaining goods and services. Summary statistics from the time use data are displayed in Table 1. The time use data covers only selected years during the period 1975-2004, so it is unsurprising to find some minor differences in the summary statistics. There are two notable differences between the PSID and the time diary data. Market hours of work are lower in the time diary data than in the PSID, consistent with the standard finding that time use data show lower hours worked than the PSID or Current Population Survey (Aguiar and Hurst 2007). Mean hours of housework is substantially lower in the time diary data; as noted by Knowles (2005) and confirmed in our data, mean hours of housework in the PSID correspond much more closely to mean hours of "home production" in the time diary data.

We use data from the CEX interview sample from 1980-2003 on unmarried female heads of household aged 25-55 (inclusive). We use the NBER's data on yearly expenditures on the 109 NIPA expenditure categories available on the NBER website.[5] We supplement these data with the raw CEX data produced by the Bureau of Labor Statistics measuring expenditures on various disaggregated expenditure categories of interest not available in the NBER data, such as expenditures on domestic service, as well as demographics including state of residence and number of children. For comparability with the NBER data, we collapse the raw CEX data to the yearly level. Summary

[5] These data have been used in numerous other settings, including Charles, Hurst, and Roussanov (2009).

statistics for the CEX are shown in Table 1. Demographics are within the range expected from the PSID, given the differing sampling methods and time periods covered. Total yearly expenditures are $18,442, of which $3,652 is spent on food, and $2,768 is spent on food at home.

3. Empirical Specifications

In our basic empirical specification in the PSID, we perform an OLS regression of usual weekly hours of time spent on an activity (market work, housework, or other time) for individual i in year t on the average net-of-tax share $(1-\tau)$, a measure of unearned income Y, a set of demographic control variables X, year fixed effects θ, individual fixed effects Γ, and an error term ε:

$$h_{it} = \beta_1(1-\tau_{it}) + \beta_2 Y_{it} + X_{it}\beta + \theta_t + \Gamma_i + \varepsilon_{it} \quad (1)$$

The effective average net-of-tax share is in turn defined as the fraction of an individual's earnings that she would keep, if she chose to work:

$$(1-\tau_{it}) = [E_{it} - (T_{w,it} - T_{nw,it})]/E_{it}$$

where E is earnings if you work, T_w is net taxes paid if you work, and T_{nw} is net taxes paid if you do not work. This measures an individual's incentive to participate in the labor force and is relevant if an individual makes a choice between stay out of the labor force and participating in the labor force and earning the pre-tax amount E. This may be the relevant choice if individuals face fixed costs of work or a discrete menu of options of numbers of hours to work.

Since earnings-if-work E is unobserved, we impute E by performing a regression of actual annual earnings on demographic variables, year effects, and an error term:

$$\ln(E_{it}) = X_{it}\beta + \theta_t + \varepsilon_{it} \quad (2)$$

The demographics included are a full set of dummies representing all possible values of age, education, number of children, and race. Since earnings are approximately lognormally distributed, we log earnings before including it in the regression; similar but slightly less precise results are obtained when we use a linear regression to impute earnings. So that zeroes of the dependent variable can be included in the regression, we

add 10 to earnings before logging it.[6] We obtain very similar results with other choices, such as adding 1 or 100 to earnings before logging it. We then form a measure of imputed earnings for each individual in each year using the coefficients estimated from this regression. Earnings are imputed for those with both positive earnings (whose actual earnings could be endogenous) and for those with zero earnings (whose earnings if they worked are unobserved). This imputation strategy bears similarities to the strategies in Meyer and Rosenbaum (2001), Eissa and Hoynes (2004), and Blau and Kahn (2007).

Using imputed earnings E_{it} for each individual in each year, we then construct simulated average and marginal tax rates using the Taxsim program of the National Bureau of Economic Research (Feenberg and Coutts 1993). We include federal and state income and payroll taxes.[7] For calculating welfare benefits, we use earnings to construct the value of food stamp and AFDC/TANF benefits if the individual does and does not work. These are constructed using the information on food stamp and AFDC/TANF generosity at different income levels in the Urban Institute's TRIM3 database. For constructing these, we incorporate exactly the same information as Meyer and Rosenbaum (2001). Since all versions of (1) include individual fixed effects, as well as controls for (at a minimum) the same demographic variables that appear in the imputation regression (2), identifying variation in constructed tax rates in (1) will derive from variation across individuals and time in national and state policy changes. We also investigate a substantial number of variants of (1), described more fully in our results section.

In repeated cross sections of data from the CEX, we impute tax rates the same way, and our basic specification is the same as (1) but lacks individual fixed effects:

$$h_{it} = \beta_1(1-\tau_{it}) + \beta_2 Y_{it} + X_{it}\beta + \theta_t + \varepsilon_{it} \qquad (3)$$

In repeated cross sections of data on time use, our specification is the same as (3), but we lack a measure of unearned income and therefore omit this from the regression:

[6] When we exclude zeroes of earnings from the income imputation, we obtain very similar but slightly less precise results.

[7] Following Meyer and Rosenbaum (2001), we do not use capital income in constructing marginal tax rates. The results are not sensitive to this choice.

$$h_{it} = \beta_1(1-\tau_{it}) + X_{it}\beta + \theta_t + \varepsilon_{it} \quad (4)$$

To hold the method constant across datasets, we use the vector of coefficients from the PSID to impute earnings and simulated tax rates in our work with the time use and CEX data.

Limitations

This basic strategy has a number of limitations, some of which are addressed in detail in the results section. It is important to note three remaining issues. First, the labor supply specification we consider can be derived from a model of utility maximization in a static context (Blundell and MaCurdy 1999). In a dynamic context, this is the correct specification only in the presence of myopia or liquidity constraints. We interpret our findings on consumption in terms of a static Becker model of consumption and time allocation, but we acknowledge that this interpretation is less clear in a dynamic model in which consumption and labor supply decisions are made jointly.

Second, in our discussion of the results, we interpret an increase in the net-of-tax rate as representing an increase in the net-of-tax wage. Single women without children are a good control group for single women with children: they are competing in the same labor market and respond similarly to economic shocks such as the unemployment rate.[8] It is therefore reasonable that demand shocks to the two groups changed their wages in extremely similar ways. Because they are competing in the same labor market, it is unlikely that the incidence of the policy changes on the pre-tax wage was different in the two groups. Importantly, we provide estimates with number-of-child-by-year fixed effects, which removes all of the variation comparing single mothers with and without children, and find comparable results. As an additional piece of evidence that the pre-tax wage was not positively correlated with the net-of-tax share, we regressed pre-tax hourly wages of labor market participants on the imputed net-of-tax share, plus age, number of child, and year fixed effects, and found an insignificant negative coefficient on the imputed net-of-tax share. We also run a selection-corrected Tobit in which the independent variable is the net-of-tax wage and find a similar elasticity of hours worked with respect to the net-of-tax wage to the elasticity with respect to the net-of-tax share.

[8] Meyer and Rosenbaum (2001) discuss the validity of this control group in detail.

Despite all of these considerations, we acknowledge that there is some uncertainty surrounding the precise magnitude of the change in the net-of-tax wage corresponding to the changes in the net-of-tax share we document, since hourly wages are unobserved for those not in the labor force.

Third, we condition the sample on being single in a given year. This implies that individuals who go from single to married are excluded from the sample, and those who choose to divorce are included in the sample. One worry is that these choices could themselves be influenced by tax variation. Alm and Whittington (1995) study the response of marriage and divorce decisions to the "marriage penalty," the additional tax liability a couple faces from the decision to get married rather than stay single. They find very small responses in the overall population, which are insignificant in most groups. In particular, they find substantial marriage responses to the marriage penalty among cohabitators, who are excluded from our sample, and little evidence of responses among other groups. Therefore, we believe that while this is a concern in principle, there is little existing evidence that the population we consider would respond to changes in tax policy, and the evidence suggests that the magnitude of the response, if any, is very small.

4. Results: Panel Study of Income Dynamics

The basic PSID results are in Table 2, organized into four panels. Panel A shows results from the PSID with a dummy for labor force participation as the outcome and a linear probability model; Panel B shows usual hours worked as the outcome; Panel C shows usual hours of housework as the outcome; and Panel D shows residual (non-housework, non-market work) time as the outcome.

Column 1 of Table 2 shows the results with the basic specification, including individual and year fixed effects, as well as a full set of dummies representing all possible values of age and number of children. The effect on labor force participation in Panel A is strong and precisely estimated. The implied elasticity of participation with respect to the net-of-tax share is .43, which falls within the existing range of estimates (.35 to 1.7, with a central elasticity of .7). It is not surprising that our elasticity falls toward the bottom end of this range, since labor force participation (by our definition) is higher in

the PSID than in other datasets that have been used. Column 1 of Panel B likewise shows a strong and highly significant effect on usual hours worked, with an elasticity of .43. The identical elasticities of the work decision and the number of hours worked suggest that, consistent with previous literature, the responsiveness of hours indeed does come along the extensive (as opposed to intensive) margin.[9]

Column 1 of Panel C shows that this corresponds to a strong negative effect of the net-of-tax share on usual hours of housework. The coefficient on the net-of-tax share variable (-14.65) is 78% as large as the coefficient (18.87) when hours worked was the dependent variable in Panel A Column 1, suggesting that most of the increase in hours worked is accounted for by decreases in time spent on housework. Column 1 of Panel D shows a smaller and insignificant decrease in other time, with a corresponding coefficient of -4.21. We depict these results in Figure 3, which shows that as the net-of-tax share rises, market work rises steadily and housework falls steadily and substantially, with a change in housework that is a substantial fraction of the change in market work in response to the net-of-tax share.[10] It is evident that two lines track each other closely.

We now turn to various specification checks. Throughout all of these robustness checks, the same pattern of results will hold: a strong positive effect of the net-of-tax share on market work, a negative effect on housework that accounts for more than half of the increase in market work, and a negative and insignificant effect on other time. Column 2 of Table 2 addresses the possibility of self-selection. We perform a Heckman selection correction and add the inverse Mills ratio to the right-hand-side of the imputation regression (2). We identify the selection term by calculating the average net-of-tax share that an individual with average income ($23,192) and their true number of children would face in a given year. We add this tax rate to the first stage predicting

[9] This is the correct inference if usual hours of work is similar for those who are on the margin of work or no work and in the population as a whole. To investigate this, we regressed usual hours of work on the number of times a woman was out of the labor force (mean 11.6) and found a coefficient of only .032 on number of times out of the labor force, with a standard error of .030. The maximum implied difference in usual hours worked between those who tend to be out of the labor force and those who tend to be in the labor force is very small.

[10] More specifically, Figure 3 shows a local polynomial regression of residuals on residuals; see notes to the Figure for details.

labor force participation but omit it from the second stage. We then estimate (2) and compute imputed incomes for each individual, on the basis of which we calculated imputed net-of-tax shares as described in Section 3. Column 2 shows results using the selection-corrected average tax rate, which yields similar results to Column 1, with somewhat larger point estimates.

Column 3 of addresses the possibility that an individual's number of children could be endogenous to tax policy. We calculate the maximum number of children that an individual has over the full sample period, rather than using the actual number of children that the individual has at a given point in time, and use this (maximum) number of children to calculate the net-of-tax share in each year. The results are again similar to Column 1, with somewhat smaller point estimates.

Column 4 adds to the regression a measure of the incentives created by transfer programs. We control for the "welfare average tax rate," defined as welfare transfers if an individual works minus welfare transfers if an individual doesn't work, as a fraction of imputed earnings. Welfare includes both food stamps and AFDC/TANF transfers.[11] The coefficient on the net-of-tax share variable is nearly unchanged from Column 1. Welfare benefits do not have a significant effect on labor supply or home production. Others, such as Meyer and Rosenbaum (2001), have also found that the EITC expansions influenced labor force participation more than other policy changes.

In Column 5, we recognize that non-labor income is not exogenously determined and instrument for it using the size of welfare benefits that an individual would receive if he or she did not work. We recognize that welfare benefits have both price and income effects on labor supply, and so we also control separately for the welfare average tax rate from Column 4. A limitation of this approach is that the welfare average tax rate is separately identified from the instrument, welfare benefits if an individual does not work, solely off functional form. This must be traded off against the gain of a plausibly exogenous source of variation in non-labor income. The results are again similar to those

[11] Meyer and Rosenbaum (2001) find no evidence for an effect of Medicaid benefits on labor supply.

in Column 1, with a slightly larger fraction of the change in market work accounted for by the change in housework. Welfare again has small and insignificant effects on market work and housework, and the coefficients on non-labor income are insignificant but substantially larger than in other specifications.

In Column 6, we address the fact that our measure of the average net-of-tax share is a noisy measure of the true fraction of earnings taken away from a given individual, both because our imputation may not measure the true earnings potential of any given individual, and because we do not have administrative data on variables such as earnings and number of dependents. To address measurement error, we form a second measure of the average net-of-tax share that an individual faces. Our second measure of the average net-of-tax share is calculated using an individual's average labor income over the full sample period. In a given year, we calculate the average net-of-tax share that each woman would face given that she earned her average labor income and faced the true tax schedule in that year. We then instrument for this measure of the average net-of-tax share using the measure based on imputed earnings that we have used in Columns 1 and 3-5. This makes a large difference to the estimated coefficients, more than doubling them relative to Column 1, and moving the implied elasticity of participation a bit above the midpoint of elasticities previously estimated in the literature. The much larger coefficient estimates suggest that, in fact, measurement error may be leading to attenuation bias in other specifications. It is important to note that the central conclusion that we take away from the tables—that approximately two-thirds of the increase in market work came from housework—still holds in this specification.

Column 7 instruments for the net-of-tax wage using the net-of-tax rate. Since wages are not observed for those who do not work, we impute wages using demographics, performing regression (2) for labor force participants with the hourly wage rate as the dependent variable. The hourly wage rate is constructed by dividing yearly earnings by yearly hours worked. The endogenous variable is then the imputed wage rate multiplied by the net-of-tax rate constructed using average earnings as in Column 6. As in Column 6, the instrument is the net-of-tax rate constructed using

earnings imputed with demographics. The coefficient on the net-of-tax wage represents the effect on hours worked or hours of housework of a $1 increase in the net-of-tax wage. While they are scaled differently, the results in Column 7 are similar to those we have found previously, both in terms of the estimated elasticity and in the sense that most of the increase in hours worked is accounted for by a change in hours of housework, with an insignificant effect on residual time.

To investigate further the responsiveness of hours worked with respect to the net-of-tax wage, we run a selection-corrected Tobit. Following the procedure suggested in Wooldridge (2002), we first run a Tobit of hours worked on the net-of-tax hourly wage and the basic control variables (omitting individual fixed effects and treating the data as repeated cross sections); for observations with positive hours, we obtain the Tobit residuals; for observations with positive hours, we regress the net-of-tax hourly wage on the basic control variables, and the average net-of-tax share computed using an individual's actual number of children and the average income over the full sample (the latter of which provides the identifying variation); obtain the fitted values; and finally run a Tobit of hours worked on the basic controls (omitting individual fixed effects) and the fitted values. The estimated elasticity of hours worked with respect to the net-of-tax wage, computed at the mean, is .37 (with a standard error of .16). This is remarkably similar to our basic estimate of an elasticity of hours worked with respect to the net-of-tax rate of .42.

Column 8 controls for various other factors that could impact labor force and housework activity: the minimum wage in the state, state GDP, the presence of a welfare waiver, imputed labor income interacted with year, state linear trends, and education-by-year fixed effects. We used five education groups: no high school diploma, high school diploma, some college, college graduate, and post- graduate. The interaction of education group with year fixed effects controls for demand shocks potentially arising from skill-biased technological change. We also tried including a dummy for whether states had a time limit for welfare receipt, which is highly correlated with the waiver

variable and made little difference to the results. The results are remarkably similar to the basic set of results in Column 1.

Column 9 adds a very stringent set of controls: number-of-child-by-year fixed effects, state-by-year fixed effects, and number-of-child-by-state fixed effects. This is particularly noteworthy since the number-of-child-by-year fixed effects take out *all* of the variation displayed in Figure 1. In other words, we know that labor force participation increased substantially for single women with children over the sample period relative to the participation of single women without children, and that the net-of-tax share rose for single women with children relative to single women without children over this period. The advantages and limitations of this differences-in-differences strategy are well understood. By putting in number-of-child-by-year fixed effects, we investigate whether other sources of variation—for example, across income groups, states and time—also drive increased hours worked and decreased housework. In addition to taking out this source of variation, state-by-year fixed effects remove the impact of state policies or other factors that affect everyone in a given state in a given year. Number-of-child-by-state fixed effects remove an additional potential source of variation. All told, the regression has well over 1,000 dummy variables. Despite all of these controls, the results still show significant increases in labor force participation and yearly hours worked, and a significant decrease in housework. The coefficients fall substantially relative to Column 1, but as before, the effect of taxes on hours of housework is greater than half of the effect of taxes on hours of market work.

We also performed other robustness checks. Meyer and Rosenbaum use information on the full distribution of wages and hours, given whether a woman does or does not have children. We took account of higher moments of the distribution of average tax rates conditional on demographics—rather than only the mean—by performing quantile regressions of earnings on our demographic variables for the 10^{th}, 20^{th}, 30^{th}…90^{th}, 99^{th} quantile of the earnings distribution. We then impute income at each of these quantiles, calculate the implied average net-of-tax share at each quantile, and for each individual at each time averaged together the implied net-of-tax shares over all

quantiles. We then use this measure of the average net-of-tax share in (1). We obtain similar results, less precise but still highly significant. We also experimented with various different combinations of the specifications in Columns 1-9, such as controlling for the welfare ATR while controlling for all of the control variables in Column 8, but also many other combinations. We continue to obtain similar results. In Column 1 of Appendix Table 1, we show the results when yearly hours of market work is the dependent variable. Putting the coefficient on the average net-of-tax rate (839.17) in weekly terms by dividing by 52 yields an estimated a weekly increase of 16.14, which is similar to the estimates in the main results when weekly hours worked is the dependent variable.

Table 3 shows an analysis of heterogeneity of the effect across population groups. Individuals under 40 show a larger reaction to the net-of-tax share than those over 40. We split the sample into halves by imputed income, in order to assess whether the policy changes tended to affect those expected to be in lower or higher income ranges. Interestingly, the point estimates suggest that among lower-income individuals, housework responds to taxation more than among higher-income individuals.

Correlations between Housework and Market Work

To investigate how market work and housework relate in the summary statistics, we regressed usual hours of market work on a dummy for participating in the labor force, individual fixed effects, year fixed effects, and the controls from our basic specification (clustering the standard errors as in the basic specification); in a second regression, we performed this regression but with usual hours of housework as the dependent variable; and in a third regression, we performed this regression but with residual time as the dependent variable. The results are shown in Columns 2 through 4 of Appendix Table 1. When individuals participate in the labor force, the decrease in their housework time accounts for only a small fraction of the increase in their hours of market work. We obtain qualitatively similar results when we omit individual fixed effects. This finding is noteworthy for two reasons. First, this is the opposite result from what we obtain using variation coming from policy changes, highlighting the important role that these changes play in identifying the results. Second, one possible objection to the main results of the paper is that individuals could inaccurately report a roughly constant sum of housework

and market work, perhaps because they feel they ought not admit that they do little work in either the market or the home. Since the raw summary statistics show that reported housework is only slightly lower among labor force participants than among non-participants, such a story cannot explain our main results.

5. Results: Time Use Data

We next examine in greater detail the effect of taxes on time use using the repeated cross sections of time diary data assembled by Aguiar and Hurst (2007). The basic results are shown in Table 4. Columns 1 and 2 show that as in the PSID, labor force participation and hours of market work rise significantly in response to an increase in the net-of-tax share. The coefficient on the net-of-tax share is somewhat higher than the basic specification in Column 1, Panel B of Table 2, but the results are well within the range estimated in the PSID. Column 3 shows that housework falls in response to an increase in the incentive to participate in the labor force. The point estimate of the fall in housework is insignificantly smaller than in the PSID, which is unsurprising since mean hours of housework is lower in the time diary data. Similarly, the broader Aguiar and Hurst measure of "Home Production" falls substantially and significantly, with a coefficient over half the size of the coefficient in Column 2. The effect on "Non-Market Work," equal to Home Production plus time spent obtaining goods and services, is similarly sized and significantly different from zero. Columns 6 through show the effect on Aguiar and Hurst's various measures of leisure, Leisure 1 through Leisure 3. The estimated effect on leisure is always negative but is only marginally significant for Leisure 2.

Columns 9 through 10 show other outcomes of interest. Time spent preparing and eating meals falls significantly, with a coefficient of substantial size; we will presently investigate the effect on food expenditures for comparison with the Becker (1965) model. Interestingly, the full time spent with children increases insignificantly, with a standard error that rules out a large decrease in time spent with children. To the extent that this regression is identified off the comparison over time of women with and without children, this result must be interpreted with caution because time spent with children is

low for women without children. Finally, "hard-working" individuals are often thought to sleep less than "lazy" individuals. In light of the view that "lazy" single mothers need motivation from policy to "work harder," it is of interest to note that sleep is insignificantly changed by an increase in the net-of-tax share.

6. Results: Consumer Expenditure Survey

Table 5 shows results using the CEX data.[12] Since time spent preparing and eating food fell in response to an increased incentive to participate in the labor force, it is of interest to test how expenditures on food changed. This is motivated by the prediction of the Becker (1965) model that in response to a (net-of-tax) wage increase, expenditures on the market input (food bought in the market) should rise relative to the time input (time spent preparing and eating food) into a commodity (ingestion of food). In Column 1 of Table 5, food expenditures show a small and insignificant response to an increased net-of-tax share. In combination with the decrease in the time use data on time spent preparing and eating food, this can be seen as supportive of the Becker model.[13] We further probe the findings on food by breaking down food expenditures into their component parts: food at home (primarily food purchased at grocery stores), food away from home (primarily food purchased from restaurants), and food at work. Column 2 shows that food away from home—which seems the most likely to substitute for time spent preparing food—rises significantly. Food at home falls significantly, while food at work rises significantly (Columns 3 and 4).

Columns 5 through 7 investigate the response of expenditures on items at polar ends of the spectrum of home production and leisure. We investigate expenditures on domestic services and major appliances in Columns 5 and 6, since these seem most likely to be substitutable with home time. The point estimates indicate that both rise, although

[12] When we run regressions in CEX of hours worked or labor force participation on the net-of-tax rate, analogous to those we ran in the PSID and time diary settings, we obtain similar results to those shown in Tables 2 through 4.

[13] The Becker model is about the time and market goods responses to a compensated wage change. Since we lack a measure of unearned income in the time use data, we could treat the estimate of the significant impact of the net-of-tax share on time spent eating and preparing food as a compensated elasticity estimate. The implied compensated elasticity of food expenditures is also insignificantly different from zero. In combination, these findings are likewise supportive of the Becker model.

the coefficients are insignificant. Expenditures on recreation and sports fall, which makes sense because these are likely to be more complementary with leisure. Overall, a reasonable conclusion to take away from the data on expenditures is that they usually respond in the expected directions, but that the sample size is usually not large enough to detect significant responses and that there should correspondingly large uncertainty about the true magnitude of the effects.

7. Conclusion

We examine how income taxes affect time allocation. We find that when individuals keep a greater fraction of their earnings when participating in the labor force, they work substantially more: the baseline estimates show an elasticity of hours worked with respect to the average net-of-tax share is .43. This represents one of the first examinations of the effect of tax incentives on hours worked using panel data and individual fixed effects. We find that this corresponds to a substantial and significant decrease in housework: the point estimates suggest that approximately three-quarters of the increase in hours worked corresponds to a decrease in housework. This result is robust to a wide variety of specification checks in the PSID and also holds in repeated cross sections of data on time use. In the repeated cross-sections of data, we find some evidence that other, non-housework time decreases significantly in response to an increase in the incentive to join the labor force. We also find some evidence that expenditures on goods that appear substitutable with housework increase in response to an increased incentive to enter the labor force.

These results have implications for several areas of economic inquiry. The finding that the increase in market work corresponds largely to a decrease in housework suggests that public policies affecting labor force incentives largely shift people from one productive form of activity to another. Insofar as the policy reforms pursued over the period in question were motivated by decreasing the "merit bad" of unproductive activity of idle single mothers, it is notable that the policies in fact shifted individuals from work at home to work in the market. The results also have efficiency implications insofar as they imply, in a two-sector general equilibrium model with home and market labor and

capital, that the taxation of market but not home labor causes a substantial distortion labor and capital across sectors (Boskin 1975). Externalities or internalities from housework or labor supply decisions would also imply efficiency implications of the tax-induced decrease in housework.

The findings can be interpreted as consistent with the classic model of Becker (1965): when the net-of-tax rate rises, implying that the net-of-tax wage rises, expenditures on food rise relative to time spent on food. The change in food expenditures is small and insignificant, but the fall in the time spent preparing and eating food is substantial and marginally significant. Collectively, we interpret this as evidence in favor of the Becker model. Insofar as we interpret our housework measure as a measure of "home production," and non-housework time as a measure of "leisure," the results do not rule out the predictions of the model of Gronau (1977), which, in the presence of preferences that are homothetic in income and fixed costs of work, predicts a decrease in both home production and leisure in response to an increase in the incentive at the extensive margin to participate in the labor force.

Our findings are perhaps surprising in view of the Burda and Hamermesh (2009) finding that employed individuals enjoy substantially less leisure time, and only a bit less home production time, than the nonemployed. The findings suggest substantial substitutability between market goods and home time, since home time falls substantially as market work rises. This is supportive of the literature in macroeconomics, spawned by Benhabib, Rogerson, and Wright (1991), that explains the magnitude of business cycle fluctuations in part through substitutability between market goods and home time, as well as other literature explaining the rise of female labor force participation over the course of the 20th century in part through the substitutability of durable goods and home time (Greenwood, Seshadri, and Yorukoglu 2005).

Future work could fruitfully investigate several further questions. Estimating a parameter corresponding to the substitutability of market goods and home time could form a useful input into macroeconomic models. In a Becker (1965) framework, it would be relevant to estimate the substitutability or complementarity of market goods and home

time for each "commodity" separately, thus addressing the question of whether activities are more like "home production" or more like "leisure" in the framework of Reid (1934). Estimating a dynamic model of labor supply-consumption decisions would also be relevant. Quantification of the distortions relating to taxing market but not home work, in a general equilibrium model with market and home capital, remains an important issue. Finally, investigating how married couples jointly make decisions about housework, labor supply, leisure, and consumption in response to public policy, and the efficiency implications thereof, would be a natural extension of the questions raised in this paper.

References

Aguiar, Mark, and Erik Hurst, "Measuring Trends in Leisure: The Allocation of Time over Five Decades," *Quarterly Journal of Economics*, 122 (2007), 969-1006.

Alm, James, and Leslie A. Whittington, "Does the Income Tax Affect Marital Decisions?" *National Tax Journal*, 48 (1995), 565-572.

Becker, Gary S., "A Theory of the Allocation of Time," *The Economic Journal*, 125 (1965), 493-517.

Becker, Gary S., and Gilbert Ghez, *The Allocation of Time and Goods over the Life Cycle* (Chicago, IL: NBER, 1975).

Benhabib, Jess, Richard Rogerson, and Randall Wright, "Homework in Macroeconomics: Household Production and Aggregate Fluctuations," *Journal of Political Economy*, 99 (1991), 1166-1187.

Blank, Rebecca M., "Evaluating Welfare Reform in the United States." *Journal of Economic Literature,* 50 (2002), 1105-1166.

Blau, Francine D., and Lawrence M. Kahn, "Changes in the Labor Supply Behavior of Married Women: 1980-2000," *Journal of Labor Economics*, 25 (2007), 393-438.

Blundell, Richard, and Thomas MaCurdy, "Labor Supply: A Review of Alternative Approaches," *Handbook of Labor Economics*, 3 (1999), 1559-1695.

Boskin, Michael J., "Efficiency Aspects of the Differential Tax Treatment of Market and Household Economic Activity," *Journal of Public Economics*, 4 (1975), 1-25.

Burda, Michael, and Daniel Hamermesh, "Unemployment, Market Work, and Household Production," NBER Working Paper No.14676, 2009.

Charles, Kerwin, Erik Hurst, and Nikolai Roussanov, "Conspicuous Consumption and Race," *Quarterly Journal of Economics*, 124 (2009), 425–467.

Eissa, Nada, and Hilary Williamson Hoynes, "Taxes and the Labor Market Participation of Married Couples: the Earned Income Tax Credit," *Journal of Public Economics*, 88 (2004), 1931-1958.

Eissa, Nada, and Hilary W. Hoynes, "Behavioral Responses to Taxes: Lessons from the EITC and Labor Supply," *Tax Policy and the Economy*, 20 (2006), 73-110.

Eissa, Nada, and Jeffrey B. Liebman, "Labor Supply Response to the Earned Income Tax Credit," *Quarterly Journal of Economics*, 111 (1996), 605-637.

Feenberg, Daniel, and Elisabeth Coutts, "An Introduction to the TAXSIM Model," *Journal of Policy Analysis and Management,* 12 (1993), 189-194.

Gelber, Alexander, "Taxation and Family Labor Supply," NBER Working Paper, 2009.

Greenwood, Jeremy, Ananth Seshadri, and Mehmet Yorukoglu, "Engines of Liberation," *Review of Economic Studies*, 72 (2005), 109-133.

Gronau, Reuben, "Leisure, Home Production, and Work—the Theory of the Allocation of Time Revisited," *Journal of Political Economy*, 85 (1977), 1099-1123.

Hamermesh, Daniel, and G.A. Pfann, eds. *The Economics of Time Use* (Amsterdam, Netherlands: Elsevier B.V., 2005).

Hotz, Joseph V., and Karl Scholz, "The Earned Income Tax Credit," in *Means-Tested Transfer Programs in the United States*, Robert Moffitt, ed. (Chicago, IL: The University of Chicago Press and NBER, 2003).

Juster, Thomas, and Frank Stafford, ed. *Time Goods and Well-Being* (Ann Arbor, MI: University of Michigan Press, 1985).

Knowles, John, "Why are Married Men Working So Much?" Working Paper, University of Pennsylvania, 2005.

Meyer, Bruce D., and Dan T. Rosenbaum, "Welfare, the Earned Income Tax Credit, and the Labor Supply of Single Mothers," *Quarterly Journal of Economics*, 116 (2001), 1063-1114.

Meyer, Bruce D., and James X. Sullivan, "The Effects of Welfare and Tax Reform: The Material Well-Being of Single Mothers in the 1980s and 1990s," *Journal of Public Economics*, 88 (2004), 1387-1420.

Meyer, Bruce D., and James X. Sullivan, "Changes in the Consumption, Income, and Well-Being of Single Mother Headed Families," *American Economic Review,* 98 (2008), 221-241.

Moffitt, Robert, "The Temporary Assistance for Needy Families Program," in *Means-Tested Transfer Programs in the United States*, Robert Moffitt, ed. (Chicago, IL: The University of Chicago Press and NBER, 2003).

Reid, Margaret G., *Economics of Household Production* (New York, NY: John Wiley and Sons, Inc., 1934).

Robinson, John, and Geoffrey Godbey, *Time for Life* (University Park, PA: Pennsylvania State University Press, 1999).

Data Appendix

Panel Study of Income Dynamics (PSID)

The PSID is a large representative longitudinal survey that contains detailed information on a wide array of topics including demographics, labor market participation, housework, and income. Individuals in family units were surveyed ever year from 1968-1997 and every two years thereafter.

Our analysis covers survey years 1976-2005 (excluding survey year 1982) because hours of housework are consistently measured only during these years. The sample is restricted to members of and movers into the core sample but excludes the poverty sample. We focus on unmarried and non-cohabitating female heads of household age 25-55 who are present in the PSID for at least two years.[14] We further exclude observations that have allocated values for hours of work and housework. Weights are used throughout to ensure the sample remains representative.

Housework

The PSID asks for usual weekly hours of housework as follows:

"About how much time do you spend on housework in an average week? I mean time spent cooking, cleaning, and doing other work around the house."

Hours worked

The PSID asks for usual weekly hours of work in the previous calendar year at both a main job and extra job, if applicable. We sum these together to create our total usual weekly hours worked variable. As a robustness check, in some specifications we use the PSID calculated annual hours worked in the previous calendar year which also incorporates weeks worked and total overtime hours.

Labor force participation

We define a binary variable for labor force participation as equal to one if the respondent has positive usual hours worked and zero otherwise.

Residual Time

We define residual time in the PSID as simply total hours in a week less usual hours of housework less usual hours of market work.

[14] Our sample excludes what the PSID calls "permanent" cohabitators defined as having lived together for at least a year or present for two or more waves of data collection. There remain a small number of "temporary" cohabitators in our sample.

Time Use Data

We draw on four cross-sections of time use data assembled and described in great detail in Aguiar and Hurst (2007).[15] These data ask respondents to account for time spent during the previous day. We use data from the 1975 Time Use in Economic and Social Accounts, the 1985 Americans' Use of Time, the 1993 National Human Activity Pattern Survey, and 2003 American Time Use Survey. We choose these datasets because they are nationally representative and overlap with the period of analysis in the PSID. We also add the 2004 year of the American Time Use Survey to increase sample size and correspond exactly with the final labor market year of analysis in the PSID.

We select our sample with the goal of being as consistent as possible across survey years as well as with the PSID sample. In all years we require non-missing data on education and number of children, as well as complete time diaries.

1975

Unmarried female heads of household age 25-55.

1985

Unmarried females who answered the telephone survey age 25-55.

1993

Female adults living in one adult household age 25-55.

2003/2004

Unmarried female heads of household age 25-55.

Outcomes of Interest

We use Aguiar and Hurst's coding of activities and refer the reader to their variable glossary.

Imputation procedure

Given the lack of consistent labor income data in the time use surveys, we instead impute labor income for each respondent using demographic information and the coefficients obtained from the PSID labor income imputation described in the text. We then feed imputed labor income into TAXSIM to calculate simulated average net of tax shares.

[15] The data are available for download at http://troi.cc.rochester.edu/~maguiar/timeuse_data/datapage.html

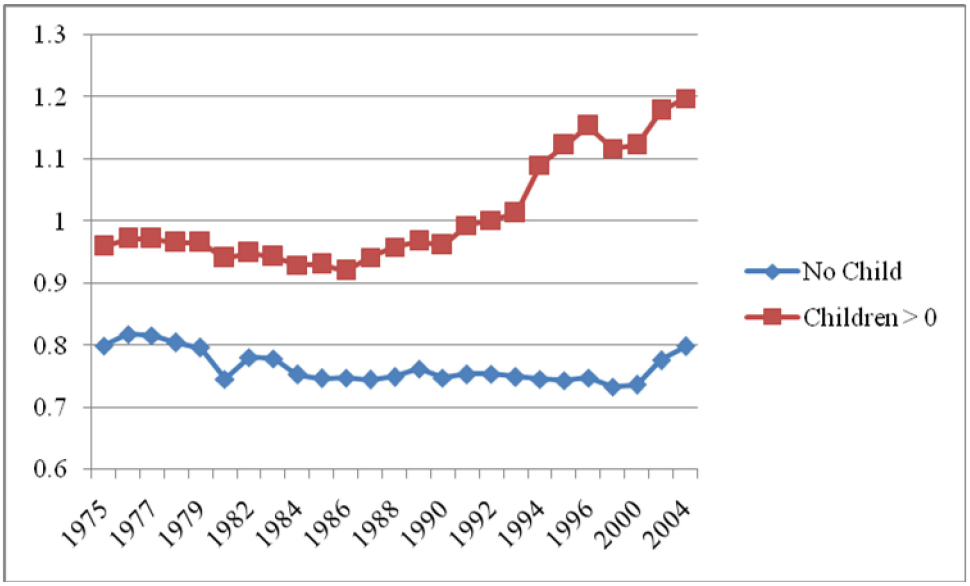
CEX

Total food, food away from home, food at home, food at work, and recreation and sports are coded to be consistent with the National Income and Product Accounts expenditure categories. Total food is calculated by summing food away from home, food at home, and food at work. Recreation and sports is calculated by summing "recreation and sports" and "other recreation."

Data on expenditures on domestic services and major appliances are taken from the quarterly CEX interview files. Domestic services include babysitting, day care, and hired help for cleaning. The underlying CEX UCC codes are 340310, 340410, 340420, 340520, 340530, 340903, 340906, 340914, 340210, 340211, 340212, and 670310. Expenditures on major appliances is calculated as expenditures on washers, dryers, stove ovens, microwave ovens, portable dishwashers, electric cleaning equipment, and refrigerators (UCC codes 300210, 300220, 300310, 300320, 300330, 320511, and 300110).

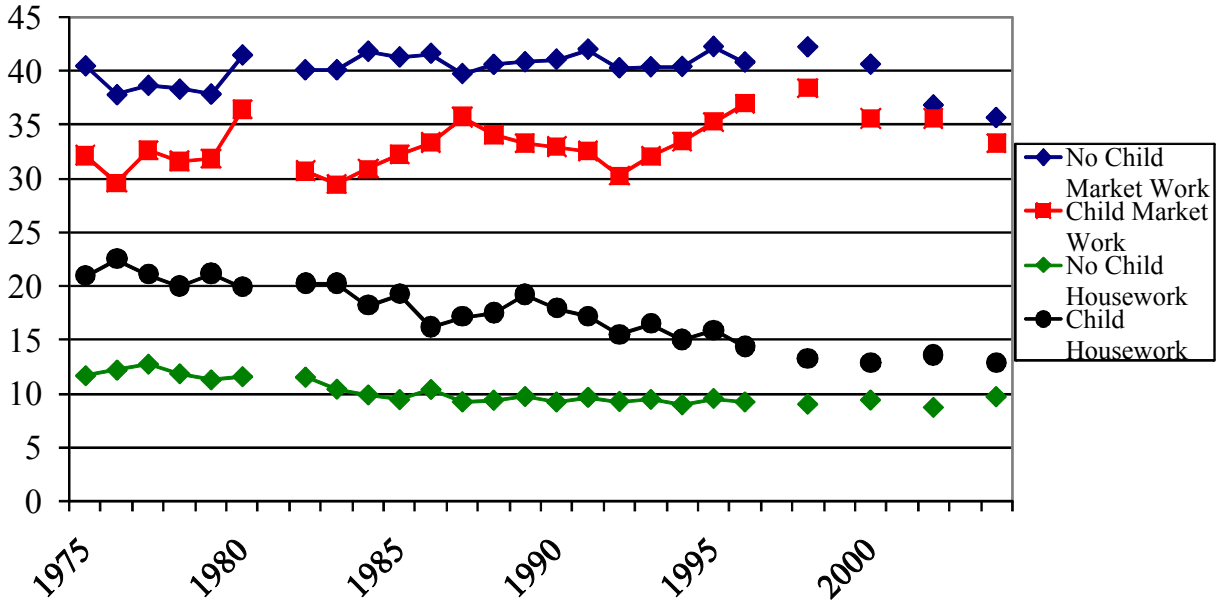
Since state of residence is missing for a substantial fraction of the sample, we use only Federal tax variation for identifying the estimates; we obtain similar results when we use the state data that are available. For comparability with the NBER data, we collapse the raw quarterly data to the yearly level by summing expenditures across a year. To address attrition we follow Charles, Hurst, and Roussanov (2009) in imputing expenditures in quarters in which an individual is missing by assuming that a woman would have spent as much in the quarters in which data is missing as the average amount she spent in the quarters in which she is in the data. The interview files have observations on more individuals than the NBER's yearly files, because the NBER's files exclude a variety of individuals. For comparability between the interview files and the NBER files, we keep only individuals who appear in the NBER data.

Figure 1. *Changes in tax rates over time: mean imputed average net-of-tax share by year for single women with and without children*



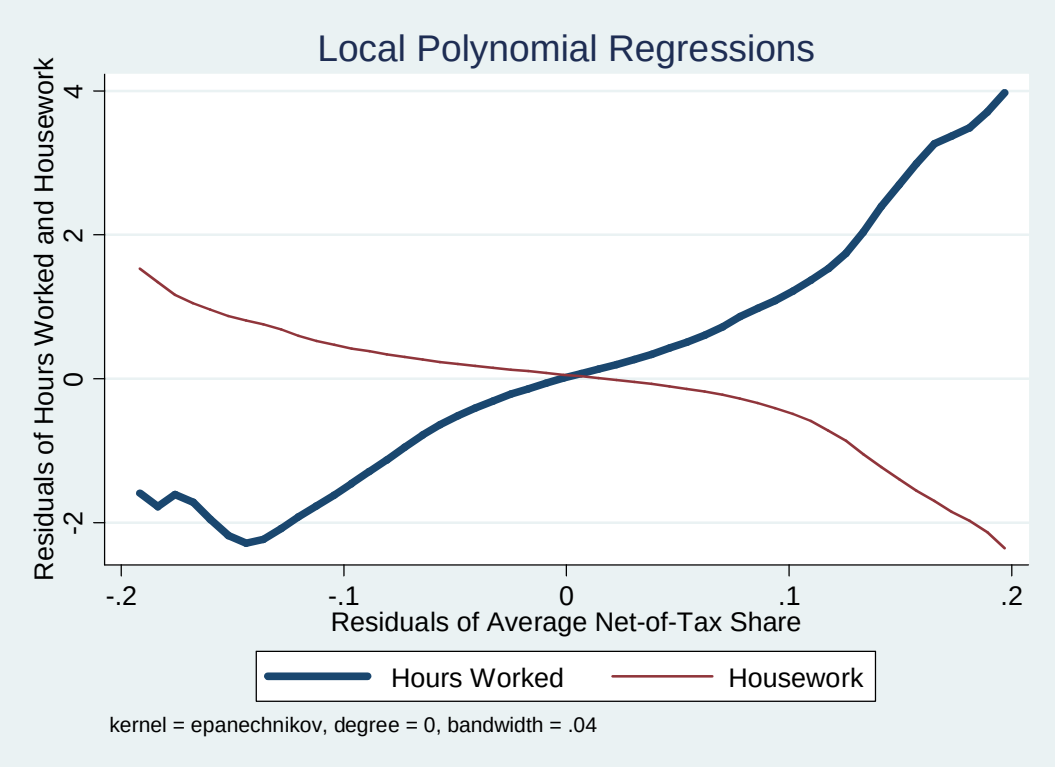
Notes: The figure shows that through a series of policy changes starting in the mid-1980s, there came to be an increasing incentive to participate in the labor force for low-income single women with children relative to those without children, because the average net-of-tax share rose substantially for single women with children relative to those without children. Average tax rates are calculated using Taxsim by calculating a woman's tax liability if she works and if she does not work, and then calculating the fraction of her earnings that would be taken away in taxes if she works. A woman's tax liability if she works is calculated by applying Taxsim to the woman's imputed earnings. Earnings are imputed by regressing earnings on age, number of children, education, and year fixed effects in the full sample and deriving the fitted values. The average net-of-tax share for women with children is greater than one primarily because the EITC transfers a substantial amount of money if a woman works, often implying that the effective tax rate is negative. The data are taken from the Panel Study of Income Dynamics.

Figure 2. *Usual hours of market work and housework of single women with and without children, 1975-2004*



Notes: The data are taken from the Panel Study of Income Dynamics. The figure shows mean usual hours worked and housework for single female heads of household, excluding cohabitators, with and without children. The figure shows that usual hours of market work increased substantially for single women with children relative to those without children from the mid-1980s to the mid-1990s, a period coincident with the tax changes shown in Figure 1. During this period, mean hours of housework fell substantially for women with children relative to those without, suggesting that much of the increase in market hours of work during this period corresponded to a decrease in hours of housework. During the period without the policy changes that differentially affected women with and without children, there is little discernable trend for single women with children relative to those without.

Figure 3. *Identifying variation: local polynomial regressions of residuals of usual weekly hours worked and housework, plotted against residuals of average net-of-tax share*



Notes: Figure 3 shows that as the net-of-tax share rises, hours worked rises steadily, and housework falls steadily. The figure shows the fitted lines produced by two local polynomial regressions. First, we regress the residuals of usual hours worked on the residuals of the imputed average net-of-tax share. These residuals are calculated by regressing usual market hours worked (or the imputed average net-of-tax share) on individual and fixed effects, as well as dummies representing all possible values of age and number of children, then partialing out the effects of the independent variables. Second, we regress the residuals of usual weekly hours spent on housework on the residuals of the imputed average net-of-tax share. These residuals are calculated similarly. We use the measure of the imputed net-of-tax share used in Column 1 of Table 2.

Table 1. *Means and Standard Deviations of Main Variables*

Panel A: PSID

	Mean (Standard Deviation)
Work > 0 Hours During the Year	.89 (.31)
Weekly Hours Worked	37.47 (17.54)
Weekly Housework	12.66 (10.55)
Weekly Residual Time	117.86 (17.75)
Average Net-of-Tax Share	.86 (.16)
Age	38.72 (8.82)
Number of Children	.71 (1.04)
N	9,242

Panel B: Time Diary Data

	Mean (Standard Deviation)
Work > 0 Hours During the Week	.75 (.43)
Weekly Hours Worked	27.34 (29.53)
Weekly Housework	6.13 (10.37)
Weekly Home Production	14.17 (15.55)
Weekly Non-Market Work	19.91 (18.69)
Weekly Leisure 1	33.83 (23.56)
Weekly Leisure 2	107.39 (27.47)
Weekly Leisure 3	112.31 (27.61)
Weekly Food Preparation and Eating	12.29 (9.85)
Weekly Sleep	59.06 (16.24)
Weekly Child Care	4.91 (9.92)
Average Net-of-Tax Share	.94 (.17)
Age	39.14 (9.04)
Number of Children	.91 (1.24)
N	4,444

Panel C: Consumer Expenditure Survey

	Mean (Standard Deviation)
Food	2846.71 (2135.78)
Food Away from Home	588.86 (879.51)
Food at Home	1799.67 (1435.43)
Food at Work	20.53 (136.66)
Domestic Services	203.55 (709.98)
Major Appliances	73.54 (281.59)
Recreation and Sports	776.91 (1220.61)
Average Net-of-Tax Share	.91 (.17)
Age	38.14 (8.78)
Number of Children	.88 (1.18)
N	22,757

Notes: The table shows means and standard deviations of central variables in the analysis. The sample is taken from the PSID data from 1975-2004. All data are weighted by the PSID cross-sectional weights (though application of the weights changes the results little). In Panel B, data are taken from repeated cross sections on time use assembled by Aguiar and Hurst (2007) and the 2004 American Time Use Survey, spanning 1975-2004. In Panel C, expenditure amounts are expressed in real 2005 dollars and the sample covers 1980-2003. The sample consists of unmarried female heads of household aged 25-55.

Table 2. *Regressions of time allocations on imputed average net-of-tax share, non-labor income, individual fixed effects, and control variables*

Panel A: Dependent Variable is Dummy for Labor Force Participation

	(1) Basic Controls	(2) Control for Self-Selection	(3) Hold # of Kids Constant	(4) Control for Welfare	(5) IV for Non-Labor Income	(6) IV for ANTR	(7) IV for Net-of-Tax Wage	(8) Extra Controls	(9) Extra Fixed Effects
ANTR	.45	.43	.29	.44	.44	1.15		.35	.28
	(.08)***	(.13)***	(.09)***	(.08)***	(.09)***	(.22)***		(.09)***	(.11)***
Non-Labor Inc.	.00008	.00006	.0001	.0001	-.01	.002	.000001	.00006	.0003
	(.001)	(.001)	(.01)	(.01)	(.02)	(.01)	(.001)	(.01)	(.01)
Welfare ATR				.05	.04			.033	
				(.04)	(.05)			(.041)	
Net Wage							.03		
							(.005)***		
R-Squared	0.04	.04	.04	.04				.06	.28
N	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242
Elasticity	.43	.42	.28	.43	.43	1.11	.40	.34	.27

Notes: "ANTR" refers to the average net-of-tax rate, calculated using income imputed with demographics, as described in the text. The average net-of-tax rate is the percentage of income that a woman would keep if she participated in the labor force. Standard errors are clustered by individual. Each regression has 1,243 clusters. All regressions control for dummies for all possible values of age and number of children, as well as individual and year fixed effects; this is also the set of "basic controls" used in Column 1. Column 2 uses a Heckman selection correction in imputing income, as described in the text. Column 3 shows results when an individual is assigned, in all years, their maximum number of children over the sample period. Column 4 controls for the incentives created by AFDC, TANF, and food stamps, summarized by the variable "Welfare ATR," equal to the difference between welfare benefits if a woman works and does not, as a fraction of earnings if she works. Column 5 instruments for non-labor income with the value of welfare received if a woman does not work. Column 6 instruments for one measure of the average net-of-tax share using another measure, as described in the text. In Column 7, we instrument for the net-of-tax wage using the average net-of-tax share. Column 8 adds controls for the state minimum wage, state GDP, the presence of a welfare waiver, imputed labor income interacted with year, state linear trends, and education-by-year fixed effects. Column 9 adds number-of-child-by-year, number-of-child-by-state, and state-by-year fixed effects. The actual coefficients and standard errors on non-labor income have been multiplied by 1,000. "Elasticity" refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Table 2, Panel B: Dependent Variable is Usual Hours of Market Work

	(1) Basic Controls	(2) Control for Self-Selection	(3) Hold # of Kids Constant	(4) Control for Welfare	(5) IV for Non-Labor Income	(6) IV for ANTR	(7) IV for Net-of-Tax Wage	(8) Extra Controls	(9) Extra Fixed Effects
ANTR	18.87	25.48	10.58	18.67	17.81	47.78		16.86	4.55
	(4.86)***	(7.76)***	(5.13)**	(4.83)***	(5.60)***	(12.28)***		(5.43)***	(6.00)
Non-Labor	-.02	-.02	-.026	-.023	-1.52	-.020	-.027	-.033	-.030
Inc.	(.06)	(.06)	(.060)	(.060)	(1.28)	(.060)	(.061)	(.060)	(.057)
Welfare				1.06	-.98			.53	
ATR				(1.83)	(2.46)			(1.89)	
Net Wage							1.24		
							(.32)***		
R-Squared	.04	.04	.04	.04				.06	.26
N	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242
Elasticity	.43	.58	.24	.43	.41	1.10	.40	.39	.10

Notes: "ANTR" refers to the average net-of-tax rate, calculated using income imputed with demographics, as described in the text. The average net-of-tax rate is the percentage of income that a woman would keep if she participated in the labor force. Standard errors are clustered by individual. Each regression has 1,243 clusters. All regressions control for dummies for all possible values of age and number of children, as well as individual and year fixed effects; this is also the set of "basic controls" used in Column 1. Column 2 uses a Heckman selection correction in imputing income, as described in the text. Column 3 shows results when an individual is assigned, in all years, their maximum number of children over the sample period. Column 4 controls for the incentives created by AFDC, TANF, and food stamps. These incentives are summarized by the variable "Welfare ATR," which is equal to the difference between welfare benefits if a woman works and does not, as a fraction of the woman's earnings if she works. Column 5 instruments for non-labor income with the value of the welfare benefits a woman would receive if she did not work. Column 6 instruments for one measure of the average net-of-tax share using another measure, as described in the text. In Column 7, we instrument for the net-of-tax wage using the average net-of-tax share. Column 8 adds controls for the state minimum wage, state GDP, the presence of a welfare waiver, imputed labor income interacted with year, state linear trends, and education-by-year fixed effects. Column 9 adds number-of-child-by-year, number-of-child-by-state, and state-by-year fixed effects. The actual coefficients and standard errors on non-labor income have been multiplied by 1,000. "Elasticity" refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Table 2, Panel C: Dependent Variable is Usual Hours of Housework

	(1) Basic Controls	(2) Control for Self-Selection	(3) Hold # of Kids Constant	(4) Control for Welfare	(5) IV for Non-Labor Income	(6) IV for ANTR	(7) IV for Net-of-Tax Wage	(8) Extra Controls	(9) Extra Fixed Effects
ANTR	-14.65	-16.17	-5.66	-14.87	-15.33	-37.11		-11.96	-7.27
	(2.36)***	(4.04)***	(1.94)***	(2.36)***	(2.96)***	(6.49)***		(2.57)***	(3.38)**
Non-Labor Inc.	.017	.018	.019	.018	-.73	.015	.020	.007	-.006
	(.021)	(.021)	(.021)	(.021)	(.81)	(.022)	(.021)	(.021)	(.020)
Welfare ATR				1.16	.16			1.07	
				(1.26)	(1.74)			(1.31)	
Net Wage							-.96		
							(.15)***		
R-Squared	.09	.09	.09	.09				.13	.29
N	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242
Elasticity	-1.00	-1.10	-.38	-1.01	-1.04	-2.52	-.91	-.81	-.49

Notes: "ANTR" refers to the average net-of-tax rate, calculated using income imputed with demographics, as described in the text. The average net-of-tax rate is the percentage of income that a woman would keep if she participated in the labor force. Standard errors are clustered by individual. Each regression has 1,243 clusters. All regressions control for dummies for all possible values of age and number of children, as well as individual and year fixed effects; this is also the set of "basic controls" used in Column 1. Column 2 uses a Heckman selection correction in imputing income, as described in the text. Column 3 shows results when an individual is assigned, in all years, their maximum number of children over the sample period. Column 4 controls for the incentives created by AFDC, TANF, and food stamps. These incentives are summarized by the variable "Welfare ATR," which is equal to the difference between welfare benefits if a woman works and does not, as a fraction of the woman's earnings if she works. Column 5 instruments for non-labor income with the value of the welfare benefits a woman would receive if she did not work. Column 6 instruments for one measure of the average net-of-tax share using another measure, as described in the text. In Column 7, we instrument for the net-of-tax wage using the average net-of-tax share. Column 8 adds controls for the state minimum wage, state GDP, the presence of a welfare waiver, imputed labor income interacted with year, state linear trends, and education-by-year fixed effects. Column 9 adds number-of-child-by-year, number-of-child-by-state, and state-by-year fixed effects. The actual coefficients and standard errors on non-labor income have been multiplied by 1,000. "Elasticity" refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Table 2, Panel D: Dependent Variable is Weekly Residual Time

	(1) Basic Controls	(2) Control for Self-Selection	(3) Hold # of Kids Constant	(4) Control for Welfare	(5) IV for Non-Labor Income	(6) IV for ANTR	(7) IV for Net-of-Tax Wage	(8) Extra Controls	(9) Extra Fixed Effects
ANTR	-4.21	-9.30	-4.93	-3.80	-2.49	-10.68		-1.12	2.71
	(4.93)	(7.77)	(4.56)	(4.89)	(6.59)	(12.43)		(5.36)	(6.35)
Non-Labor Inc.	.006	.006	.007	.005	2.25	.005	.007	.023	.035
	(.06)	(.06)	(.06)	(.056)	(1.57)	(.06)	(.06)	(.060)	(.055)
Welfare ATR				-2.22	.82			-1.98	
				(2.00)	(3.15)			(2.20)	
Net Wage							-.28		
							(.32)		
R-Squared	.03	.03	.03	.03				.07	.23
N	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242	9,242
Elasticity	-.03	-.07	-.04	-.03	-.02	-.08	-.03	-.01	.02

Notes: "Weekly residual time" is defined as time not spent on housework or market work. "ANTR" refers to the average net-of-tax rate, calculated using income imputed with demographics, as described in the text. The average net-of-tax share is the percentage of income that a woman would keep if she participated in the labor force. Standard errors are clustered by individual. Each regression has 1,243 clusters. All regressions control for dummies for all possible values of age and number of children, as well as individual and year fixed effects; this is also the set of "basic controls" used in Column 1. Column 2 uses a Heckman selection correction in imputing income, as described in the text. Column 3 shows results when an individual is assigned, in all years, their maximum number of children over the sample period. Column 4 controls for the incentives created by AFDC, TANF, and food stamps. These incentives are summarized by the variable "Welfare ATR," which is equal to the difference between welfare benefits if a woman works and does not, as a fraction of the woman's earnings if she works. Column 5 instruments for non-labor income with the value of the welfare benefits a woman would receive if she did not work. Column 6 instruments for one measure of the average net-of-tax share using another measure, as described in the text. In Column 7, we instrument for the net-of-tax wage using the average net-of-tax share. Column 8 adds controls for the state minimum wage, state GDP, the presence of a welfare waiver, imputed labor income interacted with year, state linear trends, and education-by-year fixed effects. Column 9 adds number-of-child-by-year, number-of-child-by-state, and state-by-year fixed effects. The actual coefficients and standard errors on non-labor income have been multiplied by 1,000. "Elasticity" refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Table 3. *PSID Heterogeneity Analysis: OLS regressions of time allocation outcome on imputed average net-of-tax share, non-labor income, individual fixed effects, and control variables. Dependent variable shown in column heading*

	Age Under 40			Age 40 and Over			Predicted Income Below Avg.			Predicted Income Above Avg.		
	(1) Weekly Hours Worked	(2) Weekly House-work	(3) Weekly Residual Time	(4) Weekly Hours Worked	(5) Weekly House-work	(6) Weekly Residual Time	(7) Weekly Hours Worked	(8) Weekly House-work	(9) Weekly Residual Time	(10) Weekly Hours Worked	(11) Weekly House-work	(12) Weekly Residual Time
ANTR	23.06	-14.84	-8.22	9.04	-6.83	-2.21	7.54	-12.17	4.63	12.87	-6.12	-6.76
	(7.07)***	(3.10)***	(6.86)	(7.58)	(3.73)*	(8.75)	(7.80)	(3.82)***	(8.03)	(11.56)	(4.39)	(11.79)
Non-Lab. Inc.	.059	.034	-.093	-.065	.001	.064	.069	.059	-.13	-.038	-.013	.051
	(.097)	(.042)	(.096)	(.080)	(.024)	(.080)	(.091)	(.041)	(.093)	(.086)	(.020)	(.080)
R-Sq.	.04	.08	.02	.04	.05	.04	.07	.12	.04	.04	.04	.03
N	5,275	5,275	5,275	3,857	3,857	3,857	4,869	4,869	4,869	4,173	4,173	4,173
Elas.	.55	-.99	-.06	.21	-.45	-.02	.22	-.74	.04	.23	-.49	-.04

Notes: "ANTR" refers to the average net-of-tax rate, calculated using income imputed with demographics, as described in the text. Standard errors are clustered by individual. All regressions control for dummies for all possible values of age and number of children, as well as individual and year fixed effects. "Predicted income" is the individual's expected income given their demographics (age, number of children, education level, and year). See other notes to Table 2. The total sample size is smaller than in Table 2 because singletons are dropped from the regressions, and the set of singletons is larger when a subset of the data is used. The actual coefficients and standard errors on non-labor income have been multiplied by 1,000. "Elas." refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Table 4. *Time Use Data: OLS regressions of time allocation outcome on imputed average net-of-tax share and control variables. Dependent variable shown in column heading*

	(1) LFP	(2) Hours Worked	(3) House-work	(4) Home Prod-uction	(5) Non-Market Work	(6) Leisure 1	(7) Leisure 2	(8) Leisure 3	(9) Food Prep and Eating	(10) Child Care	(11) Sleep
ANTR	.59	30.01	-11.14	-18.80	-18.41	-16.09	-22.99	-15.77	-8.24	7.22	-2.82
	(0.22)***	(14.00)**	(5.37)**	(7.26)**	(8.45)**	(13.19)	(13.09)*	(13.80)	(4.53)*	(5.30)	(9.26)
R-Sq.	.22	.09	.08	.12	.08	.05	.06	.07	.14	.24	.05
N	4,444	4,444	4,444	4,444	4,444	4,444	4,444	4,444	4,444	4,444	4,444
Elas.	.74	1.03	-1.71	-1.25	-.87	-.45	-.20	-.13	-.63	1.38	-.04

Notes: The table shows the effect of the Average Net-of-Tax Rate (ANTR) on the weekly amount of time spent on each activity in question. The data are the repeated cross sections of time use data in Aguiar and Hurst (2007), in addition to the 2004 American Time Use survey. "LFP" refers to labor force participation. The definitions of the time use outcomes can be found in Section 2. All regressions control for dummies for year, five education categories, and all possible values of age and number of children. "Elas." refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Table 5. *Consumer Expenditure Survey Data: OLS regressions of expenditure category on imputed average net-of-tax share and control variables. Dependent variable shown in column heading*

	(1) Total Food	(2) Food at Home	(3) Food Away from Home	(4) Food at Work	(5) Domestic Services	(6) Major Appliances	(7) Recreation and Sports
ANTR	-19.47	-417.85	340.80	57.58	62.06	27.72	-57.24961
	(227.28)	(173.17)**	(99.84)***	(22.24)**	(99.51)	(35.89)	120.1256
Capital	.04	.03	.02	-.0004	.01	.003	.03
Income	(.01)***	(.004)***	(.003)***	(.0003)	(.003)***	(.001)***	(.01)***
R-Squared	.12	.18	.09	.01	.05	.02	.09
N	25,395	25,395	25,395	25,395	25,395	25,395	25,395
Elasticity	-.006	-.21	.53	2.55	.28	.34	-.01

Notes: The table shows the effect of the Average Net-of-Tax Rate (ANTR) on expenditures on different items, expressed in real 2005 dollars. Total food, food away from home, food at home, food at work, and recreation and sports are coded to be consistent with the National Income and Product Accounts expenditure categories. Total food is calculated by summing food away from home, food at home, and food at work. Recreation and sports is calculated by summing the NIPA categories "recreation and sports" and "other recreation." All data are taken from the CEX interview files. All regressions control for dummies for year, five education categories, and all possible values of age and number of children. "Elasticity" refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.

Appendix Table 1. *Alternative specifications: Dependent variable shown in column heading*

	(1) Yearly Hours Worked	(2) Weekly Hours Worked	(3) Weekly Housework	(4) Weekly Other Time
ANTR	839.17			
	(236.85)***			
Participation		35.87	-4.71	-31.16
Dummy		(.71)***	(.73)***	(.94)***
R-Squared	.06	.41	.10	.26
N	9,242	9,242	9,242	9,242

Notes: "ANTR" refers to the average net-of-tax rate, calculated using income imputed with demographics, as described in the text. The average net-of-tax rate is the percentage of income that a woman would keep if she participated in the labor force. Standard errors are clustered by individual. Each regression has 1,243 clusters. All regressions control for dummies for all possible values of age and number of children, as well as individual and year fixed effects. Yearly hours worked includes hours on secondary jobs and overtime hours. The "participation dummy" is a dummy that equals one if usual weekly hours worked is positive, zero otherwise. "Elasticity" refers to the implied elasticity of the dependent variable with respect to the ANTR, calculated at the means.