Labor Force Participation Elasticities of Women and Secondary Earners within Married Couples

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Abstract

Labor supply elasticities are often used to evaluate the effect of changes in tax rates on the total hours worked in the economy. Married women have traditionally been assumed to be the so-called "marginal" workers in their households in the sense of having larger labor supply elasticities. However, those elasticities have fallen sharply in recent decades—a decline that has been attributed to greater participation rates and more generally increased career orientation among married women. Indeed, a growing share of wives earn more than their husbands, raising the question as to whether a person's sex or relative earnings is the relevant factor determining the sensitivity of participation to wage and tax rates. In this paper, we use administrative data to examine whether the woman or the lower earning spouse is the marginal worker. We present descriptive evidence on the share of women who are the primary earner and the frequency of transitions into and out of employment by sex and relative earnings. We find that the lower earning spouse, not the woman, is more likely to start and stop working. We then model an individual's work decision using a dynamic probit model to isolate the labor supply response to changes in tax rates. We estimate that the participation elasticity with respect to the net-of-tax rate of the secondary earner—the spouse who typically has lower earnings—is similar to that for women, though both of these overall elasticities are small. Participation elasticities with respect to income for both women and secondary earners are effectively zero. Our estimates are robust to several alternative models, including specifications of secondary earner.

1. Introduction

Policymakers use estimates of labor supply elasticities to understand how tax changes affect labor supply and by extension, tax revenues and economic growth. A number of researchers have estimated these elasticities, on both the participation and hours margins. While many studies estimate elasticities close to zero for married men, estimated elasticities among married women have fallen dramatically over the last 40 years and now approach those of married men. Various explanations for this trend have been presented—women's stronger attachment to the labor force, increasing levels of educational attainment, and smaller family sizes. Those also lead to a higher labor force participation rate, which reduces the number of women who could potentially enter the labor force.

At the same time, it is increasingly common for married women to be the primary earners in their families. This can be seen in data from the Bureau of Labor Statistics (BLS): The share of dual earner couples in which the wife earns more than her husband has increased from 19 percent in 1987 to 29 percent in 2012. If couples in which the husband does not work are included, the share of couples in which the wife earns more has increased from 24 percent to 38 percent over that same time period. This change suggests another reason for the decline in wage elasticities of married women. If the secondary worker in a couple is less attached to the labor market than the primary earner, and women are now more likely to be the primary earner, then one would expect to see labor supply elasticities for married women to decline over time.

In this paper, we use data derived from a panel of tax returns to examine whether the marginal worker in a couple is based on that member's sex or on his or her relative earnings. Using stylized facts, we demonstrate that the lower earning spouse transitions into and out of the labor force more frequently than wives. Notably, this result does not hold if the couple starts a family. We then estimate participation elasticities with respect to the net-of-tax rate for women and secondary earners. This allows us to directly compare the results of women and secondary earners using the same data.

This paper makes several contributions to the literature. First, participation elasticities have typically been estimated using survey data. Administrative tax return data can allow us to more accurately measure labor force participation and estimate the net-of-tax rate. Second, the panel aspect of this dataset allows us to observe how spouses transition into and out of the labor force and between being the higher- and lower-earner within the household. It also allows us to address the potential biases caused by unobserved heterogeneity. Finally, while tax return data have been used to estimate the elasticity of income, they have not been used to examine the responsiveness of labor supply to changes in tax rates. Our estimates provide additional information about whether changes in taxable income reflect changes in the secondary worker's labor force participation.

2. Literature Review

A large existing literature studies the sensitivity of labor supply to incentives such as the wage rate or the marginal tax rate. The estimated elasticities tend to be low, especially for hours worked. An exception is the elasticity along the extensive margin, in which individuals choose to work or not work for pay, for married women. Estimates of those elasticities have historically been higher than for married or single men or single women. More recent estimates for married women are much lower, suggesting that married women are less frequently the marginal worker in a household, if a marginal worker exists. Several recent articles focus on the fact that wives are more frequently the primary earner in a couple, and that the relative earnings may play a role in determining whether or not an individual holds a paid position.

Congressional Budget Office (1996) provides an overview of studies on labor supply elasticities for men and women, and for hours and participation elasticities. Table 1 of that article lists married women's participation elasticities ranging from 1.5, attributed to Rosen (1976) down to 0.1, attributed to Triest (1990). Rosen analyzes the 1967 Survey of Work Experience for Women 30 to 44 and using a Tobit procedure, estimates an after-tax wage elasticity of 2.3. Macdonald and Moffitt (1980) decompose the overall elasticity into participation and hours elasticities, concluding that 66 percent of the effect is the participation elasticity, and hence the participation elasticity is 1.5. Triest uses a Tobit model to analyze the 1983 wave of the Panel Study of Income Dynamics (PSID), estimating an elasticity of 0.27. CBO estimates that the participation elasticity is 0.1 using the Macdonald and Moffitt decomposition.

More recently, the panel aspect of the PSID has been used to account for unobserved heterogeneity that can bias elasticity estimates. Zabel (1995) uses data from the PSID to study married white women aged 25-45 in 1968, for the years 1968 through 1987. He also estimates elasticities with respect to two types of wage changes: a one year change in wages and a lifetime change in wages. Estimates of the participation elasticity for a one year change vary from 0.43 to 0.59, while the two estimates of the lifetime change are 0.99 and 1.75. He finds that the method for addressing heterogeneity substantially affects the estimated elasticities.

Recent research on married women's labor force participation has focused on the decline of estimated wage elasticity over time. Blau and Kahn (2007) and Heim (2007) each describe the changes in female labor force participation from about 1980 through 2000. Blau and Kahn note that in the 1980s female labor supply rose independent of wages and that increase slowed in the 1990s. They point out that historically women's labor supply has been much more sensitive to wages than men's labor supply because traditional gender roles lead women to substitute among work, home production, and leisure while men substitute between work and leisure. But they point out that as traditional gender roles break down, women's cross wage elasticities would approach those of men's cross wage elasticities and women's wage elasticities would approach those of men's wage elasticities.

Using March CPS data from 1980 through 2000 they estimate the wage and cross wage elasticities of married women at different points in time. They find that married women's participation elasticities with respect to their own wages fell from a range of 0.53 to 0.61 in 1980 to a range of 0.27 to 0.30 in 2000, while elasticities over the intensive margin exhibited smaller declines.

Heim (2007) also studies the decline in elasticities among married women, using March CPS data from 1979 through 2003. He estimates the decline in estimated elasticities using a series of cross-sectional analyses. He concludes that hours and participation elasticities fell substantially over those years, with participation elasticities with respect to wages falling from 0.66 down to 0.03.

Heim presents several explanations for the decline in estimated participation elasticities. First, women's average age of first marriage increases over the time period covered in the sample. That increase implies that more women have established careers before marrying, which could lead to women being more attached to the labor force towards the later years in the sample. Second, there was been a shift by women into occupations that have more stable hours and employment. Finally, the increased risk of divorce may lead women to partially insure against that risk by maintaining continuous work histories that would help them obtain or continue employment after a divorce.

Heim (2009) uses the 2001 wave of the PSID to estimate a structural model of labor supply and the effects of taxation. As in his previous work, Heim estimates elasticities for married women that are lower than most other estimates. For example, the female participation elasticity with respect to wages is in the range of 0.07 to 0.18. He also finds, unusually, that the intensive margin elasticities exceed the extensive margin elasticities. In an unpublished appendix, Heim analyzes potential reasons for the difference between these estimates and higher numbers found in other research. He shows that in both the 1986 and 2001 waves of the PSID a failure to account for heterogeneity causes a substantial increase in estimated elasticities.

A few papers have examined the importance of relative earnings for labor supply decisions. Shafer (2011) demonstrates that the labor force participation decision of women is more closely linked to her income relative to her husband's income than it is to either of their incomes in isolation. Her analysis uses the

National Longitudinal Survey of Youth from 1979-2004 and focuses on women who were in the work force when they married. Rather than separately include the wages of husbands and wives, Shafer includes the proportion of total wages in the prior year due to the wife. Using several different models, she shows that the wife's wages relative to her husband's better predicts an exit from the labor force than either her income or her husband's income. This result holds even after controlling for the possibility that women have low wages because they plan on exiting the labor force and so do not pursue career advancement.

Baldwin, Allgrunn, and Ring (2011) extend this work by estimating elasticities on the intensive margin for primary and secondary earners in dual earner couples using one percent samples of the Census in 1980, 1990, and 2000. They find that the own-wage elasticity of primary earners is greater than that of secondary earners in 1980 and 1990 and much greater than the elasticity for husbands and wives in all three years. Their results suggest that primary and secondary earner status may be more useful than that earner's sex in categorizing the marginal worker.

Bertrand, Pan, and Kamenica (2013) examine the relative incomes of a couple in the context of gender identity. They posit that some husbands have a distaste for earning less than their wives. That affects several aspects of marriage, including the marriage market, the wife's labor force participation, her income conditional on working, and the probability of divorce. The effect of relative incomes on labor force participation is estimated using data on working age women taken from the 1970 to 2000 Censuses. Relative incomes are proxied by a variable representing the probability that the wife outearns her husband, and the effect of that variable on the probability of participating in the labor force is estimated using a linear probability model. In every version of their model they find a strongly negative and statistically significant effect of relative income on women's participation.

Some researchers focus on variation in tax rates rather than variation in wage rates to estimate participation elasticities. Eissa (2002) uses data from the March Current Population Survey (CPS) before and after the Tax Reform Act of 1986, from 1984 to 1986 and then again from 1990 to 1992. She finds that high-income married women had participation elasticities with respect to after-tax wages of 0.4. Eissa and Hoynes (2004) examine the response of lower-income married men and women to changes in the earned income tax credit. Using data from the March CPS from 1985 through 1997, they examine the response of primary earners (defined to be men) and secondary earners (defined to be women) in a couple. They estimate that primary earners have participation elasticities with respect to net-of-tax wages of 0.03 while secondary earners have an elasticity of 0.27.

A related literature uses changes in tax rates to estimate the elasticity of taxable income, which include labor supply responses as well as changes in productivity and income timing. Gruber and Saez (2002) use a panel of tax data from 1979 through 1990 to estimate the effect of changes over time in the net-of-tax rate and after-tax income on the change in pretax broad income (a measure of gross income before adjustments). While the response to tax rates in this analysis includes more than participation responses, many subsequent papers which use tax data, including our own, use similar methods (see Gruber, Slemrod, and Giertz 2012 for a review). They exploit changes in federal and state tax rates over time and across the income distribution, but note that the net-of-tax rate is endogenously determined by pretax income. They address that endogeneity by instrumenting for the change in the net-of-tax rate by applying the second period tax rules to first period income, assuming real income is constant between periods. As a result, changes in the simulated net-of-tax rate are due solely to changes in tax rates and not income. Because the first period income itself might be endogenous, they add a ten-piece spline of first period income as control variables. In their preferred specification, they estimate an elasticity of income with respect to the net-of-tax rate of 0.07.

3. Empirical Framework

In this section we describe our data and our analyses. We conduct a descriptive analysis of work participation patterns in our panel and a regression analysis to isolate the effect of tax rate changes on work.

3.1 Data

Our analysis uses panel data derived from federal individual income tax returns from 1999 to 2010 drawn from a sample of filers in 1999 stratified by income (see Weber and Bryant 2005). The panel contains data from 931,836 tax returns belonging to 118,877 unique tax units, of which 52,452 are couples filing jointly. We observe data on wages derived from the W-2 and data on income derived from Schedules C, F, and SE for each spouse. In addition, the Social Security Administration provides date of birth and sex information that is matched to each taxpayer by Social Security number. In some cases where the sex is unknown, the IRS staff edits the information if the sex of the spouse is known or by examining the name of the taxpayer. Records are weighted to be representative of filers in 1999.

We restrict our sample to focus on labor supply responses to tax rate changes. Only couples in which both spouses were born after 1944 are included to avoid labor supply changes associated with retirement. We further restrict the sample to tax units filing jointly in 1999 for as long as the taxpayer filed jointly with the same spouse so that labor supply changes are unrelated to changes in marital status. About one-quarter of the observations belonging to married taxpayers under age 65 were removed because they were post-divorce or post-nonfiling. Couples in which the sex of either spouse was inconsistent or unknown were also excluded. Our final sample contains data derived from 250,652 tax returns belonging to 25,066 unique tax units. Almost two-thirds of tax units in the final sample appear in the panel for all 12 years.

3.2 Transitions Across Employment Statuses

We begin by documenting the patterns of labor force participation in our data. We define an individual as working if he or she has wages or positive self-employment income in a year. Self-employment income is measured as net earnings reported on Schedule SE (the schedule for reporting self-employment tax), if one is required to be filed, or the sum of net profit or loss from up to three Schedule Cs (the schedule for reporting personally-owned businesses, such as partnerships) and Schedule Fs (the schedule for reporting farm income). Wages are aggregated from all W-2s belonging to the individual. Our definition implies that a person is counted as employed for an entire year even if he or she works for only a few hours. Thus in our approach relatively few people become unemployed or stay unemployed and relatively more become employed or stay employed.

We examine transitions into and out of work and transitions between primary and secondary earner status using the panel aspect of the data, where the primary earner in a year is defined as the spouse with higher earnings in that year. Because we only observe total earnings in a year, not wage rates or hours worked, we cannot identify individuals who work for part of the year in every year. For each individual, we do not determine their earnings relative to their spouse's in the first and last years of each employment spell because it is likely that an individual who stops or starts working would only have earnings during part of the year, while the spouse who continued working would have earnings from the entire year. Therefore, including partial years of work would tend to overestimate the frequency that the lower earner in a couple stops or starts working. Our restriction effectively limits our analysis of transitions to couples that have some attachment to the labor force, as at least one spouse has earnings in at least three consecutive years.

We therefore compare the employment status and relative earnings in time t with those same variables in time t+2. One interesting set of comparisons are cases in which only one spouse is working in t, but both are working in time t+2. For example, when a husband works in time t and both are working in time t+2 we can compare their relative incomes in t+2 to establish how frequently the newly-working wife outearns her husband. Of even greater interest are cases in which both members are working at time t and one member has exited the labor force by t+2. By comparing exits by men, women, primary earners, and secondary earners, we can establish each group's relative attachment to the labor force.

3.3 Regression Model

We estimate the participation elasticity for three separate groups: men, women, and secondary earners. By separately estimating our model on women and secondary earners we can compare their elasticities calculated from the same data. Estimating male participation elasticities allows us to test whether those elasticities have risen as husbands are more frequently the secondary earners.

In our base model, we identify secondary earners based on a comparison of the time average of positive earnings of each spouse. On this basis the status as secondary earner does not change over time and so it cannot be correlated with the decision to work. It should also be pointed out that under this definition, couples in which one spouse never works would not have a secondary earner.

Our estimation method uses a dynamic probit model of the following form:

$$\Pr(w_{it} = 1 \mid Y_{it}, NTR_{it}, w_{it-1}, \boldsymbol{X_{it}}, c_i) =$$
$$\Pr(\beta_1\, log(NTR_{it}) + f(log(Y_{it})) + \rho w_{it-1} + \boldsymbol{X}_{it}\gamma + c_i + \varepsilon_{it} > 0) =$$
$$\Phi(\beta_1 \log(NTR_{it}) + \mathrm{f}(\log(Y_{it})) + \rho w_{it-1} + \boldsymbol{X}_{it}\gamma + c_i), \qquad (1)$$

where w_{it} is an indicator equal to 1 if the individual is working and NTR_{it} is the net-of-tax rate 1-τ_{it}. We control for after-tax nonlabor income Y_{it} flexibly by using a 5-piece spline—defined as f(·) in equation(1)—based on quintiles of after-tax income. The individual's after-tax nonlabor income equals pre-tax nonlabor income minus tax liability T_{it}. Pre-tax nonlabor income is $E_{it} + U_{it}$, the sum of the spouse's earnings and the couple's unearned income. $\boldsymbol{X}_{it}$ is a vector of additional covariates, and is the unobserved individual-level heterogeneity.

The indicator for work, w_{it}, includes both income from self-employment and businesses and wages. Because self-employment and business income is self-reported, there is a potential for underreporting of that income. As a sensitivity check, we also estimate our model where we define work and earnings solely on the basis of wages from the W-2s.

We include the age and square of age for each spouse, the number of child dependents, the number of other dependents, dummy variables for years, and the state-level unemployment rate for the appropriate sex and year obtained from the BLS' tabulations of the CPS in our vector of covariates $\boldsymbol{X}_{it}$. The age variables account for life cycle effects that might affect both work decisions and spousal income. The presence of dependents, especially children, is possibly endogenous. However, some studies have found that while labor force participation responds to fertility changes, the reverse effect is insignificant (see, for example, McNown and Rajbhandary 2003). We therefore assume that conditional on prior employment status and the spouse's income, fertility shocks are not affected by female labor force participation or the labor force participation of the secondary earner. The year dummy variables prevent conflating the effects of national economic conditions with those of federal tax rates. The state-level unemployment rate controls for local economic circumstances that could cause involuntary unemployment of the marginal worker. The means and standard deviations for our regression variables are presented in Table 1.

All dollar amounts are converted into 2012 dollars using the personal consumption expenditures deflator. In our base specification, we restrict the analysis to marginal workers whose spouses have predicted earnings exceeding $100 as individuals with extremely low earnings are likely to experience mean reversion.

3.3.1 Identifying variation in tax rates

To identify the effects of the net-of-tax rate on labor participation, we exploit variation in tax rates over time (see Gruber and Saez 2002 for a discussion of this approach). A major change in the federal rate structure occurred in 2001, with an acceleration of some provisions in 2003. During the 12 years covered by the panel, 28 states changed their tax rates. Over that period, some states increased their marginal tax rates, while others lowered marginal tax rates. Giertz (2007) raises the possibility that the state rate faced by a taxpayer may be endogenous to some degree because of migration across states. To test that idea, he compares the elasticity of broad income estimated using variation in state tax rates and again using variation in federal rates over the period 1979 to 1998. Elasticity estimates over the whole period are 0.19 and 0.22, respectively. Over the subperiod 1988 to 1998, the elasticities are 0.11 and 0.08, respectively. These similarities suggest that endogeneity due to migration has little, if any, effect on elasticity estimates.

We calculate marginal tax rates and total taxes based on payroll taxes and federal and state income taxes using the NBER TAXSIM program. In Table 2 we describe the variation in the log (NTR_{it}) faced by women and secondary earners across time and quintiles based on after-tax nonlabor income. Because of the progressive tax code, the net-of-tax rate, on average, decreases as income increases. The net-of-tax rate tends to increase over time, particularly among individuals in the higher income quintiles.

We use the tax rate on the first dollar of earnings, which is determined by an individual's nonlabor income, defined as the sum of the spouse's earnings and the couple's unearned income. Other possible measures are the tax rate on the last dollar of the marginal worker's earnings or the average of the first and last dollar rate. However, both of those measures can be difficult for the individual to calculate and because they are determined by the worker's earnings, they will be endogenous if the likelihood of working is correlated with his or her earnings. The first dollar rate is both salient and will be exogenous if nonlabor income is exogenous.

Because the tax rate is a function of earned and unearned income, it is possible that the spouse's income is endogenous. For example, there could be simultaneous shocks to both the work decision and the spouse's income, or a spouse could increase his or her income in response to an unemployment shock. If earned income can be written as $E_{it} = \delta E_{it-1} + \eta_{it}$, this would imply that η_{it} and ε_{it} are correlated. To address this we use a method similar to that used by Gruber and Saez (2002) and Giertz (2009) to create instruments: we apply a fixed growth rate to earnings from a prior year. We index the spouse's earnings from the previous year (E_{it-1}) by the growth rate of median weekly earnings by sex and state. Thus predicted earnings $\widehat{E_{it}}$ equals $g_{it} \times E_{it-1}$, where g_{it} is one plus the growth rate of weekly median earnings obtained from tabulations of the Current Population Survey (CPS) by the BLS.

Unearned income is often assumed to be exogenous, and we make that assumption here. Unearned income includes dividends, interest, and rent. Because of possible endogeneity, we omit unemployment insurance. Capital gains are excluded because gains realizations are volatile and unlikely to be related to labor force participation. Unearned income does not enter the model separately, which implies a unitary model of marriage (Rosen 1976, Heim 2007) rather than the collective model (Chiappori 1988). While the collective model is desirable in some applications, here it would force us to arbitrarily allocate taxes and deductions between earned and unearned income.

We estimate a dynamic model that includes w_{it-1} to account for the possibility that employment occurs in spells. Without w_{it-1}, our estimates will be biased because ε_{it} and ε_{it-1} would be correlated, and from above $\eta_{it-1}$and ε_{it-1} are correlated, and so η_{it-1} and ε_{it} are correlated. Thus, the prior year's work status would be correlated with both the dependent variable w_{it} and Y_{it}, leading to inconsistent estimation of the effect of NTR_{it}. Although the dynamic probit model addresses this problem, it assumes that only one lag of work status affects current work status. In the linear model discussed below we test the sensitivity of our results to the addition of more complex error structures.

Even after controlling for w_{it-1}, it is possible that NTR_{it} is endogenous if E_{it-1} is endogenous. Gruber and Saez (2002) address a similar endogenity of their instrument by adding pretax income at t-1 as a control variable. Our model controls for income by including a measure of after-tax nonlabor income Y_{it}, which is a function of E_{it-1} both through the pretax income measure and the tax liability T_{it}. In the set of linear models below we include a sensitivity test that separately estimates the effect of pretax income ($\widehat{E_{it}}$ + U_{it}) and the tax liability.

3.3.2 Additional estimation issues

To address the critique of Heim (2009) that unobserved heterogeneity can upwardly bias elasticity estimates we model c_i as a correlated random effect, using the model of Mundlak (1980) as described in Wooldridge (2010b):

$c_i = \alpha_0 + \bar{\boldsymbol{Z}}_i \boldsymbol{\alpha_1} + \alpha_2 w_{i0} + a_i,$

where $a_i \sim N(0, \sigma_a^2), \boldsymbol{Z_i} = \{\boldsymbol{Z_{i1}}, \boldsymbol{Z_{i2}}, \ldots, \boldsymbol{Z_{iT}}\}$, $\boldsymbol{Z_{it}} = [NTR_{it}, \mathrm{f}(Y_{it}), \boldsymbol{X_{it}}]$, and $\bar{\boldsymbol{Z}}_i$ is the time average of each element of $\boldsymbol{Z_{it}}$. Dynamic probits also suffer from what is known as the initial conditions problem, which we address by the method in Wooldridge (2010). That solution assumes that the distribution of c_i is conditional on w_{i0}, which we implement by adding w_{i0} as a control variable.

Dynamic probit models have been developed for balanced panels, but because individuals exit our sample when they stop filing or get divorced, our regression sample is unbalanced. Nevertheless, we can still estimate our model consistently if conditional on our explanatory variables, the distribution of c_i is independent of the number of times the individual is observed. We test that by estimating the effect of the previous year's employment status on the probability of exiting the sample, conditional on w_{i0}, and find that employment status has an insignificant effect. We follow Wooldridge's (2010b) method to account for our unbalanced panel by interacting the number of years the individual is in the sample, T_i, with the time averages $\bar{\boldsymbol{Z}}_i$ and also including a set of indicators for the number of years the individual is observed. The variance associated with work is also allowed to vary with the number of years an individual is observed in the panel. This partially accounts for differences across individuals who are in the sample for different lengths of time.

Another potential source of sample selection is our identification of the secondary earner. We define the secondary worker as the spouse whose average earnings over the years he or she works is lower. But if the distribution of earnings is sufficiently skewed, it is possible that a person is designated as the secondary earner even if he or she has greater earnings than his or her spouse in most years. We use three alternative definitions of secondary earner in robustness checks. First, we identify the secondary earner as the spouse with lower earnings in 75 percent or more of the years he or she is observed. Under this definition a spouse who never works would be classified as the secondary earner. Second, we project the log of earnings on indicators for state, year, sex, number of dependent children, age, and age squared for men and women separately using full years of work. We then calculate predicted earnings for each spouse and identify the secondary earner as the spouse with lower projected earnings. Third, we identify the secondary earner as the spouse with lower relative earnings two years ago, with earnings from two years ago imputed with earnings from three years ago if the individual worked for a partial year two years ago. This provides a comparison with the analysis of transitions in and out of the work. It can produce inconsistent estimates because a person will not be the secondary earner in a given year—and so will not be in the dataset—if the earner experiences a large positive wage shock.

We calculate the average partial effect of covariate j as

$$APE_j = \widehat{\beta}_j \sum_{i=1}^{N} p_i \phi\left(\frac{\boldsymbol{Z_t}\widehat{\boldsymbol{\beta}} + \sum \widehat{\psi}_r 1[T_i = r] + \sum 1[T_i = r]\overline{\boldsymbol{Z_i}}\widehat{\vartheta}_r}{\exp(\sum 1[T_i = r]\widehat{\omega}_r)^{1/2}}\right) \quad (2)$$

where p_i are stratification weights such that $\sum p_i = 1$, $\widehat{\omega}_r$ is the estimated variance for couples in the sample r years, and $\widehat{\beta}_j$is the estimated coefficient from a heteroskedastic probit. The function $1[T_i = r]$ is equal to one when $T_i = r$ and 0 otherwise. The variance is modeled on the set of indicators for the number of years the individual is in the sample. We estimate equation (1) using clustered standard errors and use the delta method to calculate the standard error of the associated *APE*. For each group—men, women, and secondary earner—we estimate the elasticities of interest, those of the net-of-tax rate and nonlabor income, as

$$elasticity_j = \frac{APE_j}{\sum_{i=1}^{N} p_i 1[w_{it} = 1]} \quad (3)$$

Although we conduct sensitivity tests of the model in equation (1), we are somewhat limited by the use of a dynamic probit model. To provide additional intuition of our results and investigate how they are affected by the assumptions placed on the correlation between work and the spouse's earnings, we begin by estimating a linear probability model on the pooled data:

$$w_{it} = \beta_0 + \beta_1 \log(NTR_{it}) + \mathrm{f}(\log(Y_{it})) + \rho w_{it-1} + \boldsymbol{X}_{it}\gamma + \varepsilon_{\mathrm{it}} \quad (4)$$

After estimating this naïve model, we include additional complexity in our model. We control for unobserved heterogeneity by separately estimating a fixed effect model and a model with w_{it-1} as an explanatory variable. We consider the effect of flexibly controlling for income using a five-piece spline based on quintiles and estimate a model using stratification weights. Although fixed effects and the lagged endogenous variable both control for many unobservable characteristics, using both also allows us to control for serial correlation in employment status. Alternative assumptions of the correlation in work status across time are modeled by estimating fixed effects models with AR(1) and then ARMA(1,1) error structures. We also test the effect of using stratification weights in the fixed effect regression and the effect of separately including pretax income and tax liability as controls.

4. Results and Discussion

4.1 Stylized facts

Wives earned more than their husbands in about 24 percent of couples in 1999. We categorize couples into quintiles based on the couple's total earnings to examine how the share of women who outearn their husbands varies across the income distribution. In the bottom quintile, the wife is the sole earner in about 12 percent of couples (see Figure 1). In another 15 percent of couples, both spouses work and the wife earns more. Outside of the bottom quintile, the share of couples in which only the wife works drops sharply, as does the share of couples in which only the husband works. The most common arrangement in every quintile is that the husband is the primary earner in a two-earner couple, and the share of these households increases through the first four income quintiles. From this it appears that women are frequently the secondary earners or they are out of the labor force. If women are always the lower earner it is irrelevant if the marginal worker is determined by a person's sex or by relative income. However, there is a substantial share of dual earner couples in which the woman is the primary earner, ranging from about 15 percent in the bottom quintile to 19 percent in the top quintile. In the top three income quintiles, two earner couples in which the wife is the primary earner are more common than couples in which the husband is the sole earner. Similar patterns appear if only wages are included.

To disentangle the entry and exit from the labor force by women and secondary earners, we examine transitions over two-year periods into and out of employment by sex and by relative earnings status. As described in the previous section, we exclude two-year transitions that begin or end in a year that is the first or last year of an employment spell. Therefore the analysis of transitions only counts "work" among individuals who had earnings in at least three consecutive years.

In the most common situation (44.1 percent of the transitions), both spouses worked, and the husband earned more than his wife in the initial year and two years later (see Table 3, panel 1). The next most common pattern was that the husband was the sole earner in both years (18.8 percent) and the third most common pattern was that both worked and the wife out-earned her husband (13.6 percent). Overall, in 82 percent of cases the employment status of the couple does not change between the initial year and two years later.

This persistence also can be viewed by examining the frequency of outcomes for each initial state (see Table 3, panel 2). For two earner couples, the primary earner in the first year is usually still the primary earner two years later. If the husband is the primary earner, in 84 percent of the cases he is still the primary earner in a dual-earner couple two years later. Similarly, the wife is still the primary earner in 73 percent of the cases. However, wives who are primary earners are more likely to become secondary earners than are husbands who are primary earners. If the wife is the primary earner in the first year, in 20.2 percent of the cases she is the secondary earner two years later, while if the husband is the primary earner in the first year, in 9.5 percent of the cases he is the secondary earner two years later.

A similar pattern occurs when a single earner in a couple is joined by his or her spouse two years later. Regardless of the sex of the single earner in the first year, in about 11 percent of transitions the other member starts working but earns less. But if the wife is the sole worker, in 8.8 percent of the cases the husband starts working and becomes the primary earner. If the husband is the sole worker, in 1.4 percent of the cases the wife starts working and becomes the primary earner. The intuition for this asymmetry can be seen in Figure 1. When wives are the sole earner the family income is frequently in the first income quintile, while couples in which the husband is the sole earner are more evenly distributed across the quintiles. Thus, if the husband starts working and is paid the median salary for men he is very likely to become the primary earner, but if the wife starts working and is paid the median salary for women she is less likely to become the primary earner. The effect of assortative mating will alter the probabilities to the degree that taxpayers with similar incomes will tend to marry each other, but the underlying intuition remains.

When a member of a two-earner couple stops working, relative earnings plays a much stronger role than does that member's sex. When the female is the primary earner, in 4.6 percent of the cases the male stops working but in only 1.8 percent of the cases the female stopped. If the male is the primary earner, in 4.9 percent of the cases the female stopped working but in only 1.5 percent of the cases the male stopped.

The predominance of relative earnings in determining which member of the couple stops working can be seen in Table 4, in which we use the results of Table 3 to examine just instances in which one member of a two-earner couple exits the labor force. If the female is the secondary worker, she is the exiting member of the couple 76.8 percent of time. If the male is the secondary worker, he is the exiting member 71.9 percent of the time. It is clear, then, that relative earnings play a larger role than a person's sex in determining which member exits the labor force.

The exception to this pattern is when the tax unit expands from having no dependent children to claiming one or more dependent children. In that case, women are more likely to stop working than the lower earner. In dual earner couples with a female primary earner, if one member stops working, 67 percent of the time it is the woman. Among couples with a male primary earner, if one member exits it is almost always—94 percent of the time—the woman.

These results may poorly describe the greater importance of earnings if women are very infrequently in the labor force. For example, individuals who work alternating years are not tallied in our transition matrix because employment spells lasting at least three years are required. If those individuals are primarily women, our results will mistakenly de-emphasize the role of their gender in determining the marginal worker in a couple. As an alternative, we examine the number of years before either spouse stops working for the first time among couples who were dual earner couples in 2000 (see Figure 2). Among dual earner couples with a male primary earner, in about 80 percent of couples the husband worked continuously since 2000 (only 20 percent have ever stopped working for at least a year), while only about 40 percent of these couples have a wife continuously working (about 60 percent have ever stopped working). Those results would be consistent with women being the marginal worker in the household. But among couples in which the wife is the primary earner, the male secondary earner is more likely to stop working sooner than the female primary earner. Again, while the member's sex appears to play a role, the relative earnings of the husband and wife plays a larger role.

4.2 Regression results

We begin by estimating equation (1) for women and men separately (see table 5). For women, employment status in the prior year is positive and statistically significant, as expected. Increases in one's own age increases the probability of work, conditional on other variables, until age 42 and declines after that. The spouse's age, on the other hand, decreases the probability that she works as the spouse ages. The coefficient on unemployment is positive, but statistically insignificant. The coefficient on is 0.11 and is statistically significant, with a z score of 2.53. None of the spline variables for income are statistically significant. Children and other dependents decrease the probability that a woman works, though only the number of children has a statistically significant effect. For men, previous employment status is a strong determinant for working in the current period. Unlike the case for women, both the number of children and the number of other dependents are positive but statistically insignificant.

A 1 percent increase in the net-of-tax rate increases the probability that a woman works by 1.5 percentage points, on average (see table 6). The woman's nonlabor income, or the household income assuming she does not work, has virtually no effect on the likelihood that she works and is statistically insignificant. We would expect nonlabor income to have a negative effect—marginal workers in couples with additional resources would be less likely to work—but we generally do not find evidence of this. When we expand our sample to include all women without restrictions based on her spouse's predicted earnings, our estimates of the average partial effects are essentially the same.

For men, changes in the net-of-tax rate and nonlabor income have statistically and economically insignificant effects on their work decisions. The low responsiveness of men's labor supply participation with respect to tax rates and income is consistent with previous estimates using survey data. Almost all—92 percent—of men work in years of our panel and a substantial number have wives with no or very low predicted earnings. Restricting the regression to men whose wives had predicted earnings above $100 effectively limits the sample to men with after-tax nonlabor income in the second quintile and above. An analysis that includes all men without income restrictions fails to converge.

Using our base specification for secondary workers—those with relatively lower average earnings conditional on working—a 1 percent increase in the net-of-tax rate results in a 1.6 percentage point increase in the probability of work. While this effect is small, it is still statistically significant. The effect of income is essentially zero and is statistically insignificant.

These estimates translate into participation elasticities with respect to the net-of-tax rate of 0.003 for men and 0.02 for both married women and secondary workers (see table 7). At first glance, this result appears to be inconsistent with our descriptive analysis, which shows that secondary earners are more likely to enter and leave work than are women and in particular, being the secondary earner is a far more important determinant of exit than that person's sex. However, that does not imply that women and secondary workers respond differently to factors such as tax rates, as our regression results show. The similarity of the elasticities suggests that changes in their work status are primarily affected by factors other than changes in tax rates. Our low estimated participation elasticities also suggest that changes in taxable income in response to changes in tax rates (Gruber and Saez 2002, Saez, Slemrod, and Giertz 2012) are not likely to be driven by participation changes among the marginal worker in a couple.

These elasticities are small, although they are similar to estimates of the participation elasticity with respect to own wages in Heim (2007). Our estimates differ from those estimated by Heim (2007) and others in several ways. First, we examine changes in participation with respect to net-of-tax rates, not own wages. Individuals may be more responsive to their own wage rates than their first dollar net-of-tax rate, which is likely to be less salient. Second, we include self-employed individuals in our analysis, while they are excluded in most analyses using survey data because of data issues. However, if we only include wages in our definition of work and income, our estimates of the effect of the net-of-tax rate and income on the probability of work remain unchanged (see table 8).

We examine whether the effect of the net-of-tax rate or nonlabor income differs across the income distribution. For women and secondary earners separately, we rank individuals by the average after-tax nonlabor available to them during the panel and categorize them into quintiles. For each quintile, we estimate equation 1 but include the log of after-tax income without a spline. We do not see a systematic relationship between estimated elasticities and the individual's location in the income distribution (see Figure 3). For women and secondary earners, the elasticity with respect to the net-of-tax rate is lower in the first three nonlabor income quintiles and higher in the top two quintiles, though it peaks in the fourth quintile. A similar pattern is observed for the elasticity with respect to income among women. For secondary earners, however, the elasticity with respect to income oscillates across income quintiles.

In our preferred specification, the secondary earner in the household is the spouse with lower average earnings, based on the years he or she is working. Our elasticity estimates are robust to alternative definitions of the secondary earner. The responsiveness of work participation to changes in the net-of-tax rate is comparable whether the secondary earner is defined on the basis of having lower average earnings or lower projected earnings (see table 9). If, however, the secondary worker is defined on the basis of having lower earnings in 75 percent of the years the couple is observed in the panel, the decision to work is substantially more responsive to changes in the tax rate—a 1 percent increase in the net-of-tax rate increases the share who work by 3.9 percent. Two factors contribute to the higher elasticity using this definition of secondary earner—the estimated average partial effect is slightly higher compared to other definitions and a lower share of secondary earners in this group work. Nevertheless, the elasticities are still much lower than found in much of the literature.

We also consider how alternative treatments of our unbalanced panel can affect results. In our base specifications, we address the unbalanced panel by projecting the unobserved heterogeneity on time averages of all the explanatory variables and interacting those coefficients with the number of years the individual is present in the sample. Alternatively, we can force a balanced panel by dropping individuals who are not observed all 12 years. This excludes about 35 percent of the records in the regression for women and about one-third of the records in the regression for the secondary worker. Forcing a balanced panel results in statistically insignificant estimates of the average partial effect for the net-of-tax rate and nonlabor income for women and for secondary earners because the effects become less precisely estimated (see table 10). For women, the estimated elasticity with respect to the net-of-tax rate is about one-fifth as large, while estimated elasticities with respect to income tend to be lower. The reduction in estimated elasticities is due to smaller estimates of the average partial effects, not differences in the share of women working across the balanced and unbalanced panels. For secondary earners, the estimated elasticity with respect to the net-of-tax rate is similar using the balanced or unbalanced panel.

Our estimated participation elasticities using a dynamic probit model are lower than those previously estimated, so we estimate several linear models to investigate aspects of our modeling approach that might account for our low estimates. We start by estimating the elasticity of the net-of-tax rate with a linear probability model applied to pooled data. The log of income enters as a simple continuous variable rather than as a spline. The estimated elasticity is 0.33 for women and 0.13 for secondary workers (see Table 11). Heim (2009) concludes that estimated elasticities increase if there is unobserved heterogeneity. Our results suggest that that issue is particularly acute for women. We account for that heterogeneity using several methods.

First, we re-estimate the model using fixed effects. The elasticity for women drops to 0.04 and the elasticity for secondary workers drops to 0.06. Alternatively, we add previous employment status to a pooled model. In a pooled model, this acts as a proxy variable that controls for features that previously affected the work decision, including omitted characteristics that are always present and fixed or relatively fixed over time. The resulting elasticities are 0.08 for women and 0.05 for secondary earners. Both sets of results are consistent with Heim's conclusion.

Simply pooling together observations can upwardly bias the estimated elasticity of women if wives have a greater tendency to not work as their husband's earnings increase. Controlling for her nonlabor income addresses this problem to some degree because that includes her husband's earnings. However, if the effect is nonlinear in income—so that wives of high-income husbands respond differently than those with lower income husbands—the response could be attributed to NTR_{it}, which is a nonlinear function of income.

We test this by separately re-estimating the pooled model with a five-piece spline for income and excluding women who never work. Using the spline reduces the elasticity of women to the range of our other estimates. Excluding women who never work cuts the elasticity in half, suggesting that women who never work account for some, but not all, of the heterogeneity. Because our pooled model for secondary workers excludes individuals who never work, those estimates are not affected by secondary workers who are permanently unemployed.

Another test of this theory is to use stratification weights in the regression. In a properly specified model, weighting observations based on an explanatory variable will not affect the estimates. If more heavily weighted observations within particular ranges of an explanatory variable changes the elasticities, the model may be misspecified. Applying weights to the pooled model without lagged employment status or an income spline drops the elasticity for women to 0.11, suggesting that a model in which income enters as a simple log is misspecified.

Although we can estimate a model that includes both fixed effects and a spline for income, adding lagged employment status may still be useful in correcting for any problems caused by employment spells. The resulting elasticities suggest, however, that serial correlation in employment does not have a strong effect on our estimates. To test the sensitivity of that result, we discard lagged employment status and consider modeling the error term either as an AR(1) or an ARMA(1,1). Neither model results in elasticities outside the range of our other estimates. Applying stratification weights as an additional specification test suggests that there is little remaining specification error.

Finally, we estimate a model separately controlling for pretax income and tax liability in two splines. This tests for possible bias in the net-of-tax elasticity caused by an endogeneity of the spouse's income. Although including after-tax income controls for that problem to some degree, Gruber and Saez (2002) solve a similar problem by controlling for pretax income. Explicitly controlling for pretax income separately from tax liability does not substantially change the estimated net-of-tax elasticity.

5. Conclusion

We use panel data derived from federal income tax returns and information returns to examine work participation patterns and estimate the elasticity of participation with respect to the net-of-tax rate for women and secondary earners. While administrative data has some advantages over survey data for measuring tax rates and work participation, there are also some limitations. Work is defined on the basis of having positive wages or self-employment income in a year, so that our definition of unemployed is quite stringent. For an individual to be measured as not working, he is she would need to be unemployed for an entire calendar year. As a result, our measure of work classifies individuals who were unemployed for most of the year as working.

In our data, the frequency with which women are the primary earner in two earner couples is relatively constant across income quintiles. The frequency with which a member of a couple exits the work force is much more closely related to the relative earnings than the person's sex: more than 70 percent of the exits are by the lower earner, regardless of sex. This indicates that the marginal worker is frequently the secondary earner. Our analysis of transitions is limited to couples in which at least one spouse had earnings in at least three consecutive years to enable us to determine who is the primary earner based on earnings when working the entire year. This sample restriction is likely to exclude individuals with a weak attachment to the labor force—for example, individuals who have earnings every other year would not be included—and possibly overstate the extent to which people remain in the same work status over two year periods. However, an analysis of the length of time before an individual stops working for all two-earner couples in the initial year confirms that secondary earners of both sexes stop working sooner than primary earners of either sex.

We use a dynamic probit model to estimate the participation elasticity for married women and for secondary earners, defined as the spouse with the lower average earnings when he or she works. Using our preferred specification, we estimate a participation elasticity with respect to the net-of-tax rate of 0.02 for married women and for secondary earners. These elasticities, while statistically significant, are smaller than most other estimates of elasticities with respect to wages. Participation elasticities with respect to income for both women and secondary earners are extremely low—they are generally below 0.001 and are statistically insignificant. Our results are robust to alternate methods for identifying the secondary earner in a couple.

To place our estimates from a dynamic probit model in context, we estimate a series of simpler linear models to determine which assumptions contribute to our low estimated participation elasticities. We find that accounting for heterogeneity in taxpayer responses—either through using a fixed effects model, including a spline for income, employing stratification weights, or including lagged work status—substantially reduces estimated elasticities with respect to the net-of-tax rate.

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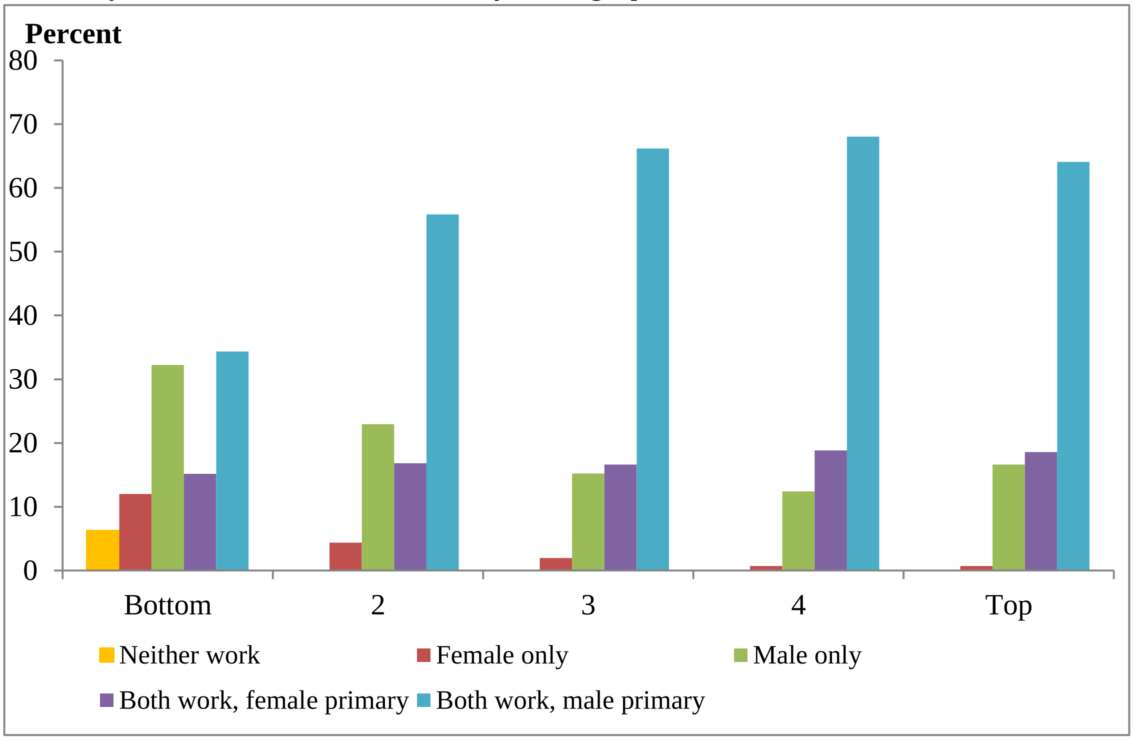
Figure 1

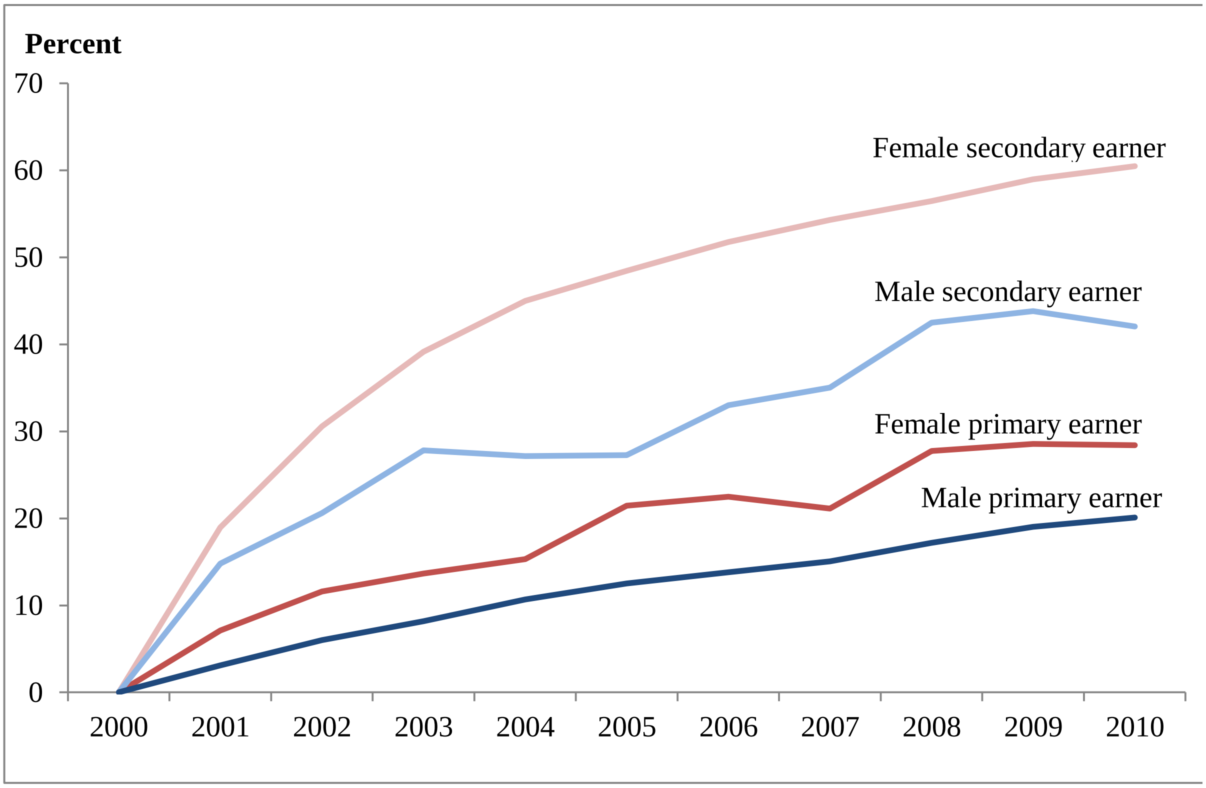
Share of joint filers in each work status, by earnings quintile, 1999



Notes: Observations weighted to be representative of the filing population in 1999. Earnings includes wages and positive self-employment income.

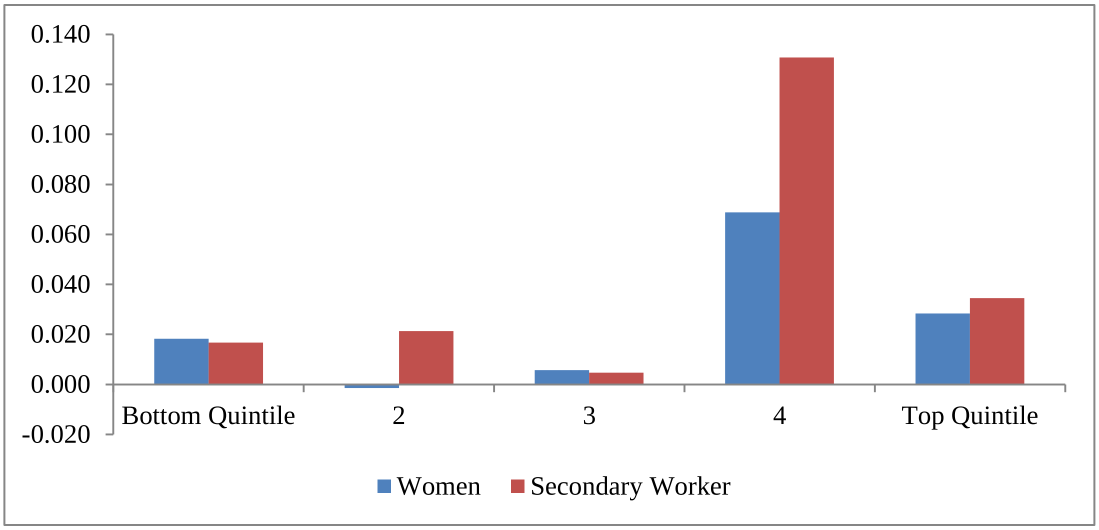
Figure 2

Probability that spouse in dual earner couple exits by year, by sex and relative earnings status of exiting spouse



Notes: Sample consists of couples in which both spouses worked in 2000. Relative earnings status based on wages and positive self-employment income in 2000.

Figure 3
Elasticities of work, by income quintile
Panel A. Elasticity with respect to net-of-tax rate



Panel B. Elasticity with respect to after-tax nonlabor income

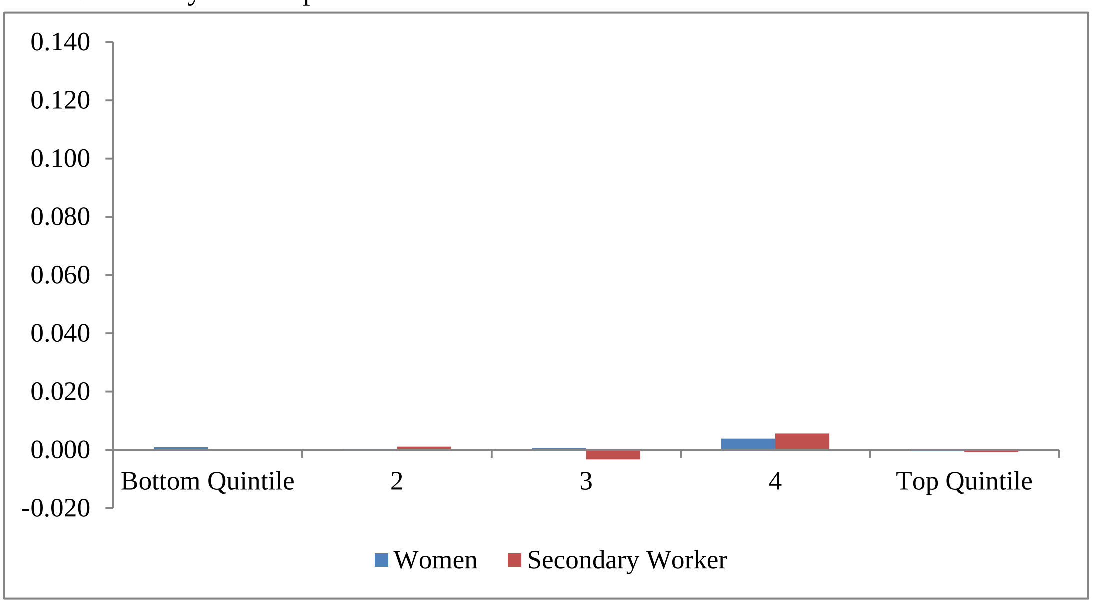


Table 1

Summary statistics of individuals in dataset

Variable	Mean	Standard Deviation
Log (net-of-tax rate)	4.41	0.26
Log (after-tax nonlabor income)	8.40	4.17
Number of children	1.38	1.22
Number of other dependents	0.05	0.28
Unemployment rate	5.59	2.00
Age	44.50	9.06
Age squared	2,061.99	799.27
Percent who work	84.37	36.31
Number of person-years	501,304	

Note: Weighted to be representative of the filing population in 1999.

Table 2
Variation in log net-of-tax rate, by year and income quintile

Panel A. Log net of tax rate faced by women

Year	Income quintile				
	Bottom	2	3	4	Top
2000	4.710	4.300	4.302	4.273	4.045
	(0.17)	(0.215)	(0.083)	(0.086)	(0.112)
	[1739]	[4517]	[3579]	[3300]	[10360]
2001	4.687	4.345	4.301	4.281	4.070
	(0.167)	(0.207)	(0.114)	(0.088)	(0.123)
	[1862]	[3847]	[3570]	[3379]	[10050]
2002	4.685	4.346	4.290	4.292	4.087
	(0.171)	(0.208)	(0.124)	(0.079)	(0.126)
	[2031]	[3666]	[3472]	[3326]	[9514]
2003	4.694	4.384	4.305	4.312	4.139
	(0.169)	(0.189)	(0.125)	(0.07)	(0.125)
	[2274]	[3268]	[3358]	[3323]	[9245]
2004	4.688	4.386	4.297	4.312	4.136
	(0.168)	(0.204)	(0.143)	(0.066)	(0.126)
	[2195]	[3069]	[3128]	[3179]	[9293]
2005	4.682	4.390	4.297	4.311	4.129
	(0.166)	(0.205)	(0.131)	(0.063)	(0.126)
	[2056]	[2948]	[2987]	[3055]	[9266]
2006	4.671	4.388	4.294	4.314	4.132
	(0.166)	(0.203)	(0.135)	(0.08)	(0.121)
	[1922]	[2696]	[2785]	[3046]	[9409]
2007	4.664	4.388	4.295	4.312	4.130
	(0.159)	(0.194)	(0.124)	(0.066)	(0.121)
	[1962]	[2554]	[2614]	[2922]	[9404]
2008	4.657	4.391	4.292	4.315	4.155
	(0.153)	(0.204)	(0.133)	(0.072)	(0.132)
	[2364]	[2531]	[2565]	[2829]	[8678]
2009	4.698	4.427	4.255	4.317	4.157
	(0.167)	(0.216)	(0.157)	(0.075)	(0.14)
	[2658]	[2323]	[2483]	[2754]	[8271]
2010	4.700	4.430	4.264	4.319	4.154
	(0.162)	(0.219)	(0.157)	(0.083)	(0.137)
	[2752]	[2461]	[2359]	[2498]	[7713]

Panel B. Log net of tax rate faced by secondary worker

Year	Income quintile				
	Bottom	2	3	4	Top
2000	4.594	4.235	4.308	4.257	4.057
	(0.225)	(0.16)	(0.049)	(0.091)	(0.111)
	[1880]	[3982]	[3153]	[2809]	[7071]
2001	4.620	4.251	4.315	4.268	4.082
	(0.192)	(0.159)	(0.064)	(0.09)	(0.121)
	[1794]	[3444]	[3098]	[2977]	[6995]
2002	4.630	4.245	4.316	4.277	4.097
	(0.186)	(0.161)	(0.066)	(0.082)	(0.119)
	[1742]	[3377]	[3041]	[2913]	[6704]
2003	4.633	4.285	4.318	4.304	4.147
	(0.188)	(0.151)	(0.084)	(0.066)	(0.121)
	[1850]	[2975]	[3011]	[2933]	[6576]
2004	4.633	4.282	4.315	4.305	4.144
	(0.189)	(0.172)	(0.089)	(0.063)	(0.122)
	[1778]	[2777]	[2815]	[2909]	[6592]
2005	4.627	4.284	4.313	4.304	4.141
	(0.182)	(0.17)	(0.085)	(0.061)	(0.123)
	[1634]	[2643]	[2735]	[2769]	[6654]
2006	4.620	4.278	4.314	4.306	4.143
	(0.178)	(0.167)	(0.091)	(0.08)	(0.117)
	[1549]	[2403]	[2574]	[2755]	[6790]
2007	4.612	4.287	4.312	4.303	4.141
	(0.172)	(0.169)	(0.083)	(0.064)	(0.118)
	[1559]	[2255]	[2433]	[2670]	[6826]
2008	4.615	4.285	4.307	4.303	4.160
	(0.169)	(0.164)	(0.097)	(0.066)	(0.124)
	[1842]	[2136]	[2395]	[2577]	[6381]
2009	4.654	4.299	4.276	4.307	4.161
	(0.188)	(0.173)	(0.129)	(0.068)	(0.13)
	[2009]	[1996]	[2279]	[2559]	[6088]
2010	4.656	4.302	4.282	4.308	4.157
	(0.184)	(0.172)	(0.134)	(0.072)	(0.126)
	[2215]	[2008]	[2132]	[2368]	[5649]

Notes: Income quintiles based on nonlabor income of individual. Numbers in each year-income quintile cell show mean, standard deviation, and number of observations.

Table 3
Transitions Between Employment Statuses Across Two Year Periods

Panel 1: Share of all transitions

Percent		Year t+2					
		No workers	Only female works	Only male works	Both work, female primary earner	Both work, male primary earner	Row Total
	No workers	1.3	0.1	0.3	0.0	0.1	1.7
	Only female works	0.1	3.7	0.1	0.5	0.4	4.9
Year t	Only male works	0.5	0.1	18.8	0.3	2.5	22.2
	Both work, female primary earner	0.1	0.9	0.3	13.6	3.8	18.7
	Both work, male primary earner	0.1	0.8	2.6	5.0	44.1	52.6

Panel 2: Share of transitions, by initial state

Percent		Year t+2					
		No workers	Only female works	Only male works	Both work, female primary earner	Both work, male primary earner	Row Total
	No workers	73.5	6.1	14.7	1.7	4.0	100.0
	Only female works	3.0	76.1	1.2	10.9	8.8	100.0
Year t	Only male works	2.1	0.4	85.0	1.4	11.2	100.0
	Both work, female primary earner	0.3	4.6	1.8	73.0	20.2	100.0
	Both work, male primary earner	0.2	1.5	4.9	9.5	84.0	100.0

Note: Work is defined by the presence of wages or positive self-employment income

Weighted to be representative of the 1999 filing population.

Table 4

Share of exiting workers among dual earner couples, by relative earnings and sex

Sex of secondary earner	Sex of exiting worker	
	Male	Female
Male	71.9	28.1
Female	23.2	76.8

Note: Work is defined by the presence of wages or positive self-employment income. Observations are weighted to be representative of the 1999 filing population.

Table 5
Estimated probit coefficients on probability of working

Covariate	Women (1)	Men (2)	Secondary Worker (3)
Worked in last year	2.418	2.389	2.19
	(0.015)	(0.029)	(0.014)
Worked in 1999	0.498	0.621	0.196
	(0.012)	(0.027)	(0.013)
log (net-of-tax rate)	0.11	0.036	0.099
	(0.043)	(0.054)	(0.047)
log (after-tax income), 1st quintile	-0.001	n. a.	0.006
	(0.005)		(0.005)
log (after-tax income), 2nd quintile	0.006	0.002	0.006
	(0.004)	(0.006)	(0.004)
log (after-tax income), 3rd quintile	0.006	-0.003	0.007
	(0.003)	(0.005)	(0.004)
log (after-tax income), 4th quintile	0.005	-0.001	0.002
	(0.003)	(0.005)	(0.004)
log (after-tax income), 5th quintile	0.003	-0.006	-0.001
	(0.003)	(0.004)	(0.003)
Age	0.069	0.045	0.099
	(0.019)	(0.038)	(0.028)
Age square	-0.001	-0.001	-0.001
	(0.0002)	(0.0003)	(0.0002)
Age of spouse	-0.056	0.002	-0.08
	(0.029)	(0.045)	(0.036)
Age of spouse squared	-0.0003	-0.0003	-0.00004
	(0.0002)	(0.0003)	(0.0002)
Unemployment rate	0.0004	-0.013	-0.011
	(0.006)	(0.007)	(0.005)
Number of children	-0.033	0.005	-0.038
	(0.008)	(0.013)	(0.008)
Number of other dependents	-0.036	0.012	-0.032
	(0.028)	(0.037)	(0.027)
Mean of dependent variable	0.76	0.92	0.80
Number of observations	199,839	138,521	168,979

Notes: Standard errors clustered by individual in parentheses. Base specification excludes individuals whose spouses have predicted earnings below $100. All regressions include year dummies and heterogeneity projected on time averages of all explanatory variables. Work is defined as the presence of wages or positive self-employment income.

Table 6
Average partial effects on probability of working

Covariate	Women (1)	(2)	Men (3)	Secondary Worker (4)	(5)
	Base	No income restriction	Base	Base	No income restriction
log (net-of-tax rate)	0.015	0.020	0.0030	0.016	0.0225
	(0.006)	(0.006)	(0.0087)	(0.007)	(0.006)
log (after-tax income), 1st quintile	-0.0002	-0.0001		0.0011	0.0001
	(0.0008)	(0.0006)		(0.0007)	(0.0005)
log (after-tax income), 2nd quintile	0.0008	0.0004	0.0001	0.0010	0.0004
	(0.0005)	(0.0005)	(0.0009)	(0.0006)	(0.0005)
log (after-tax income), 3rd quintile	0.0009	0.0005	-0.0003	0.0012	0.0006
	(0.0005)	(0.0005)	(0.0007)	(0.0006)	(0.0004)
log (after-tax income), 4th quintile	0.0007	0.0003	-0.0001	0.0004	-0.0001
	(0.0005)	(0.0004)	(0.0007)	(0.0005)	(0.0004)
log (after-tax income), 5th quintile	0.0004	0.0000	-0.0005	-0.0002	-0.0005
	(0.0004)	(0.0004)	(0.0007)	(0.0005)	(0.0004)
Mean of dependent variable	0.76	0.76	0.92	0.80	0.80
Number of observations	199,839	223,135	138,521	168,979	180,556

Notes: Standard errors calculated using delta method in parentheses. Base specification excludes individuals whose spouses have predicted earnings below $100. All regressions include lagged work status, work status in 1999, age and age squared for both spouses, number of children, number of other dependents, year dummies, and state unemployment rates. Work is defined as the presence of wages or positive self-employment income.

Table 7
Elasticity of work participation

	Women		Men	Secondary Worker	
	(1)	(2)	(3)	(4)	(5)
	Base	No income restriction	Base	Base	No income restriction
Net-of-tax rate	0.020	0.027	0.0032	0.020	0.0282
After-tax income, 1st quintile	-0.0002	-0.0001	n. a.	0.0013	0.0002
After-tax income, 2nd quintile	0.0007	0.0006	0.0010	0.0012	0.0004
After-tax income, 3rd quintile	0.0012	0.0007	-0.0003	0.0008	0.0008
After-tax income, 4th quintile	0.0009	0.0004	-0.0001	0.0007	-0.0001
After-tax income, 5th quintile	0.0006	-0.00004	-0.0005	-0.0002	-0.0006

Notes: Work participation is defined as having wages or positive self-employment income in a year.

Table 8
Elasticity of work participation using wages only

	Women	Men	Secondary Worker
	(1)	(2)	(3)
	Base	Base	Base
Net-of-tax rate	0.027	0.0035	0.021
After-tax income, 1st quintile	-0.001	n. a.	0.002
After-tax income, 2nd quintile	0.0001	0.00002	0.001
After-tax income, 3rd quintile	0.001	0.0004	0.001
After-tax income, 4th quintile	0.001	0.0012	0.0005
After-tax income, 5th quintile	0.0003	0.0008	-0.0001

Notes: Work participation is defined as having wages in a year.

Table 9
Elasticity of work participation using alternative definitions of secondary worker

	(1) Average earnings conditional on working	(2) Lower earnings 75 percent or more of the time	(3) Projected earnings	(4) Relative earnings two years ago
Net-of-tax rate	0.020	0.039	0.020	0.026
After-tax income, 1st quintile	0.001	0.0002	-0.00002	0.002
After-tax income, 2nd quintile	0.001	0.001	0.001	0.002
After-tax income, 3rd quintile	0.001	0.002	0.001	0.002
After-tax income, 4th quintile	0.001	0.0004	0.001	0.001
After-tax income, 5th quintile	-0.0002	0.0004	0.0004	0.001

Notes: Work participation is defined as having wages or positive self-employment income in a year.

Table 10
Elasticity of work participation using balanced panel

	Women	Secondary Worker
	(1)	(2)
Net-of-tax rate	0.004	0.017
After-tax income, 1st quintile	-0.0014	0.0005
After-tax income, 2nd quintile	0.0010	0.0013
After-tax income, 3rd quintile	0.0003	0.0011
After-tax income, 4th quintile	-0.0001	-0.00002
After-tax income, 5th quintile	-0.0004	-0.0005
Number of observations	128,348	114,202

Notes: Sample restricted to individuals observed in all 12 years of panel.

Table 11

Estimated elasticities of net-of-tax rate on work status from linear probability model

Model	Log (income)	Dynamics	Women	Secondary Worker
Pooled	Continuous	No lag	0.33	0.13
FE	Continuous	No lag	0.04	0.06
Pooled	Continuous	Lag	0.08	0.05
Pooled	Spline	No lag	0.02	0.01
Pooled, weighted	Continuous	No lag	0.11	0.02
FE, weighted	Spline	Lag	0.02	0.02
FE	Spline	No lag	0.03	0.04
FE	Spline	Lag	0.02	0.03
FE, AR (1)	Spline		0.02	0.01
FE, ARMA (1, 1)	Spline		0.03	0.01
FE, pretax income and tax liability	Spline	Lag	0.02	0.01

Notes: Clustered standard errors in parentheses. Excludes individuals whose spouses have predicted earnings below $100. All regressions include age and age squared for both spouses, number of children, number of other dependents, year dummies, and state unemployment rates. Work is defined as the presence of wages or positive self-employment income. FE=fixed effects.