Single Women's Labor Supply Elasticities: Trends and Policy Implications

Kelly C. Bishop
Duke University

Bradley T. Heim
Duke University

Kata Mihaly
Duke University

October 6, 2005

PRELIMINARY AND INCOMPLETE – DO NOT CITE

Abstract

This paper examines whether single women's labor supply elasticities have decreased over the past quarter century. Results from the base specification suggest that hours wage elasticities and income participation elasticities have decreased by substantial percentages, with a 67% decrease in hours wage elasticities and a 70% decrease in participation income elasticities. When the sample is cut to include women in the Outgoing Rotation Group and a direct report of the wage is used, the participation wage elasticity also exhibits a decrease of 66%. These decreases appear to be centered among divorced women and women with children, where the magnitude of the elasticities and of the decreases is much larger. These results imply that changes in tax policy had a much larger effect on women in this subpopulation in the early eighties than it has in recent years.

Address: Bradley Heim, Box 90097, 213 Social Sciences Building, Department of Economics, Duke University, Durham, NC 27708. Phone: (919) 660-1814. Email: bheim@econ.duke.edu

1 Introduction

It is well documented that, over the past few decades, female labor force behavior has undergone substantial changes. Labor force participation rates among women have increased markedly, as have their annual hours of work. In fact, such patterns have now been mentioned in two chapters of the handbook of labor economics, both in Killingsworth and Heckman (1986) and Blundell and MaCurdy (1999).

At the same time, the marital composition of women has undergone a substantial change, with the proportion of married women falling steadily over time. In 1979, for example, over 75% of female respondents to the Current Population Survey between the ages of 25 and 55 were married women. By 2003, however, that proportion bordered on 60%. There has also been a marked increase in the proportion of women who are divorced or have never been married. As a result, single women comprise a greater share of the labor force, and hence their behavioral responses to changes in wages and incomes carry even greater importance for the effects of changes in tax and transfer policies

Despite the large increase in the number of single women over the past quarter century, single women's labor supply behavior received relatively little attention, especially when compared to the vast literature on the labor supply of married women. For example, we could find only one paper that focused, even partially, on estimating labor supply elasticities for all single women.[1] Single mothers have received greater coverage, but this literature has typically been focused on the effects of the EITC on the

[1] See Kimmel and Kniesner (1998)

labor supply of these women.[2] However, single women with children only comprise about 40% of all single women.

In a recent paper Heim (2005) finds that over the period 1979-2003 not only have hours worked and labor force participation rates of married women changed dramatically, but their wage and income elasticities have changed as well.[3] That paper showed that, over the past quarter of a century, wage elasticities on the extensive and intensive margin have fallen by approximately two thirds and income elasticities have decreased by more than one fourth. These findings have large implications for tax and transfer policy, suggesting that married women will respond much less to changes in income tax rates or the EITC than they had two decades ago. However, that paper did not examine single female labor supply, so whether these changes apply to single women as well remains an open question.

Adding to the importance of examining the labor supply behavior of single women is the fact that a recent aim of tax and transfer policy has been to encourage labor supply among single women, particularly among single women with children. The Earned Income Tax Credit, for example, is primarily received by single women with children, who comprised about 75% of the recipients in 2000,[4] and several papers have attempted to estimate the labor supply and labor force participation impacts of recent expansions of the EITC. However, these expansions to the EITC primarily occurred in the early 1990's. As a result, if labor supply behavior has changed for single women as

[2] See, for example, Eissa and Liebman (1996), Keane and Moffitt (1998), Meyer and Rosenbaum (2000, 2001), Ellwood (2000), Hotz et al (2002), and Grogger (forthcoming), and others.
[3] Similar results are found in Blau and Kahn (2005).
[4] See Committee on Ways and Means (2000).

well, the estimates garnered from previous expansions of the EITC may not be a good guide for the effects of future expansions.

In this paper, then, we estimate labor supply elasticities for single women, both on the intensive and extensive margins. Using data from the Current Population Survey that spans a 25 year period, we estimate a separate elasticity for each year of data. As a result, we can examine both the level of elasticities, and any change in these elasticities that may have occurred over this period. This is of importance for three reasons.

First, since there has been relatively little work on estimating labor supply elasticities for single women, such results will add to our limited understanding of single women's labor supply behavior.

Second, a possible rationale for the falling married female labor supply elasticities found in Heim (2005) is that there has been a change in the composition of married women. If more women with large wage and income elasticities tend to be single in recent years, such a shift would tend to decrease the estimated labor supply elasticities among married women. If this is the case, one would expect to see labor supply elasticities among single women rising over this period.

Third, if single women's labor supply elasticities have been changing, these changes need to be taken into account in evaluations of possible changes in tax and transfer policy. This is especially true for estimated elasticities among single women with children. Therefore we estimate these elasticities separately for this group to examine the extent to which they differ from single women without children, and the extent to which they have changed within this group over time.

This paper examines whether single women's labor supply elasticities have decreased over the past quarter century. Results from the base specification suggest that hours wage elasticities and income participation elasticities have decreased by substantial percentages, with a 67% decrease in hours wage elasticities and a 70% decrease in participation income elasticities. When the sample is cut to include women in the Outgoing Rotation Group and a direct report of the wage is used, the participation wage elasticity also exhibits a decrease of 66%. These decreases appear to be centered among divorced women and women with children, where the magnitude of the elasticities and of the decreases is much larger. These results imply that changes in tax policy had a much larger effect on women in this subpopulation in the early eighties than it has in recent years.

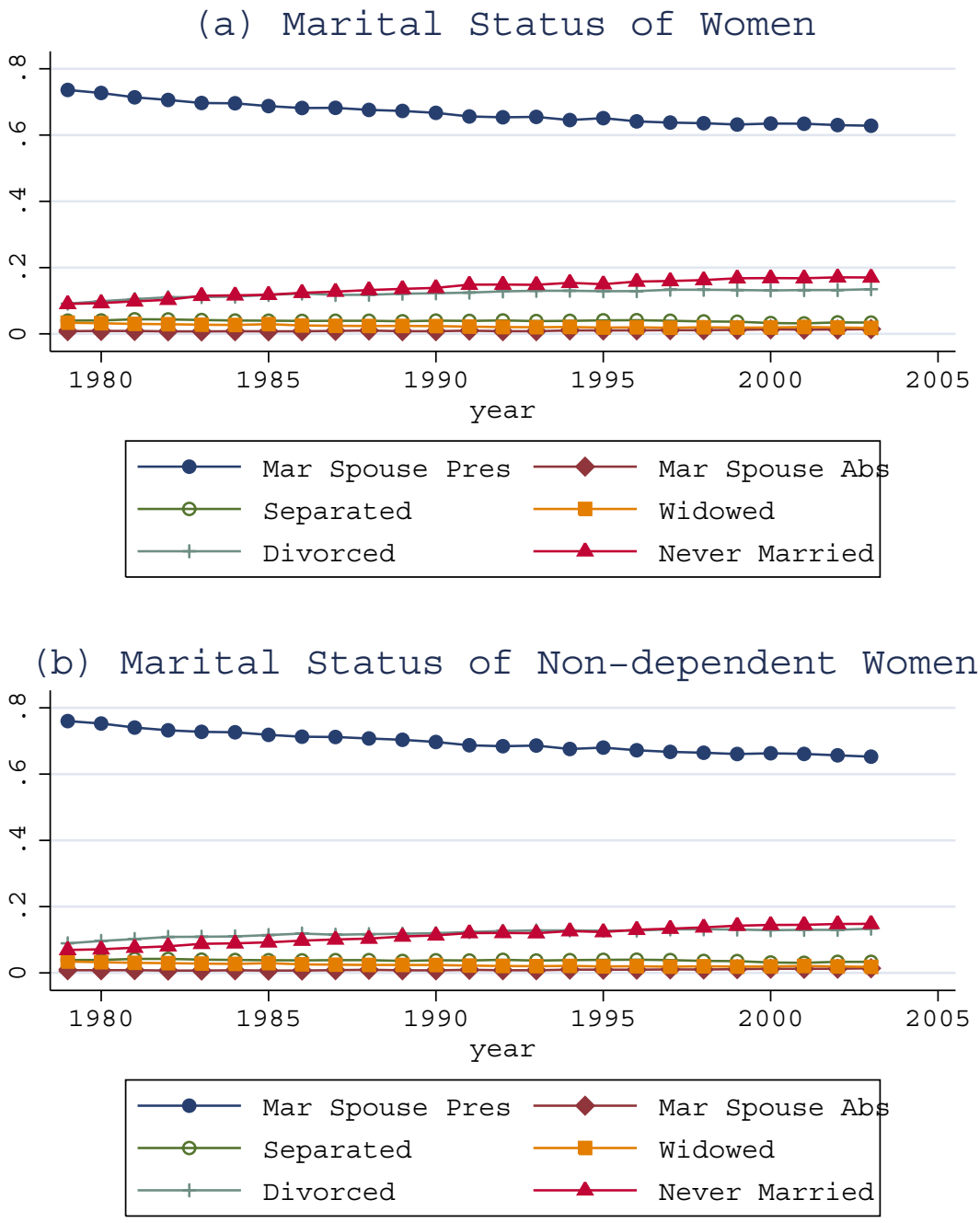
The paper proceeds as follows. In Section 2, we present data on the changing martial composition of women, and trends in the dependent and independent variables used in the estimation. In Section 3, we describe relevant tax and transfer policy changes over the past 25 years. Section 4 describes the data and estimation method used. Section 5 presents trends in estimated wage and income elasticities along the extensive and intensive margins for all single women and single women broken into subgroups. In Section 6, we describe the implications of our results for future tax policy. Finally, Section 7 concludes.

2 The Changing Composition of Women

There has been a marked transformation in the composition of women by marital status, in labor force participation and labor supply behavior, and in variables that affect women's labor force participation and labor supply behavior over the past 25 years.

In Figure 1, we present information on the marital status of women over the years 1979-2003, using data from the March Current Population Survey (CPS). In the CPS,

Figure 1 - The Composition of Women by Marital Status



women reported their marital status as being one of 6 categories: Married (with spouse present or absent), separated, divorced, widowed, or never married. We cut the sample two ways. First, we include all women between the ages of 25 and 55, inclusive. Second, we cut the sample to include only single women who were the head of household respondent to the CPS questionnaire, and call this group "Non-dependent Women." This is done to exclude single women who may be living with parents or other relatives.

From Figure 1 panel (a) it can be seen that the number of single women has been growing. In 2003, single women made up 40% of all women, as compared to 25% in 1979. One explanation for this trend is the reported increase in the divorce rate, which would imply an increase in divorced women and a decrease in married women. Interestingly, however, the percentage of divorced women has only increased from 10 to 13 percent of the population over this period. This trend is consistent with the actual divorce rate, which peaked in 1979 at 5.3 per 1000 in the population, and had fallen to 4.0 per 1000 by 2001.[5] Further, since the CPS only asks the current marital status of the women being interviewed, and since 75% of women remarry within 10 years of their first divorce, many formerly divorced women would be coded as married in these figures.[6]

Interestingly, a larger change in the marital composition of women has been driven by an increase in women who are never married, which has increased from 8 to 15 percent of the population over this time period, surpassing the proportion of divorced women in 1996. This trend is consistent with the increasing age at first marriage over this period, which was 22.1 in 1979, and increased up to 25.3 by 2003.[7] As a result,

[5] http://www.census.gov/prod/2004pubs/03statab/vitstat.pdf
[6] http://www.cdc.gov/nchs/data/series/sr_23/sr23_022.pdf
[7] http://www.census.gov/population/socdemo/hh-fam/ms2.pdf

conditional on being single, the percent of divorced women surveyed by the CPS has stayed constant at just under 40%, while the number of women who never married has increased from 35% to 48%, as can be seen in Figure 2.

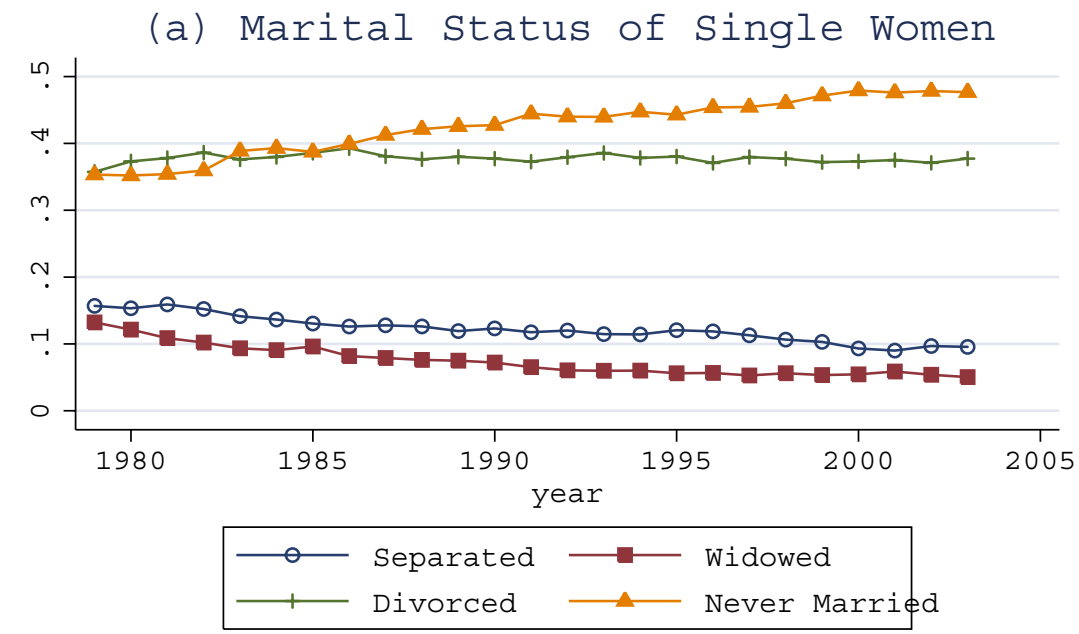
In panel (b) of Figure 1, when we look at women who are reported as heads of households and who are not living with parents or other relatives, we see similar trends. The proportion of these women who were never married also surpasses the proportion who were divorced, although at a later date than for all single women. Considering the change in society's acceptance of single women living alone, this is not an unusual finding. However, since there is no clear difference between all single women and those reported as heads of household, we concentrate on the sample of all single women for the rest of the paper.[8]

As previously discussed, the literature that has addressed the labor supply of single women has typically focused on those who have children. However, over 60% of single women in 2003 did not have children, as can be seen in Figure 3. In addition, over this period the composition of single women by number of children has stayed fairly constant, with a slight increase in the number of women with no children and a slight drop in the number of single women with 3 or more children.

In addition to changes in marital status, there have been substantial changes in the rates of labor force participation and in labor supplies. In Figure 4, labor force participation rates, average unconditional hours of work, and average hours of work conditional on working are presented for all of the years in our sample.

[8] Initial estimations were performed using both sample cuts, and the results were qualitatively similar.

Figure 2 - The Changing Composition of Single Women



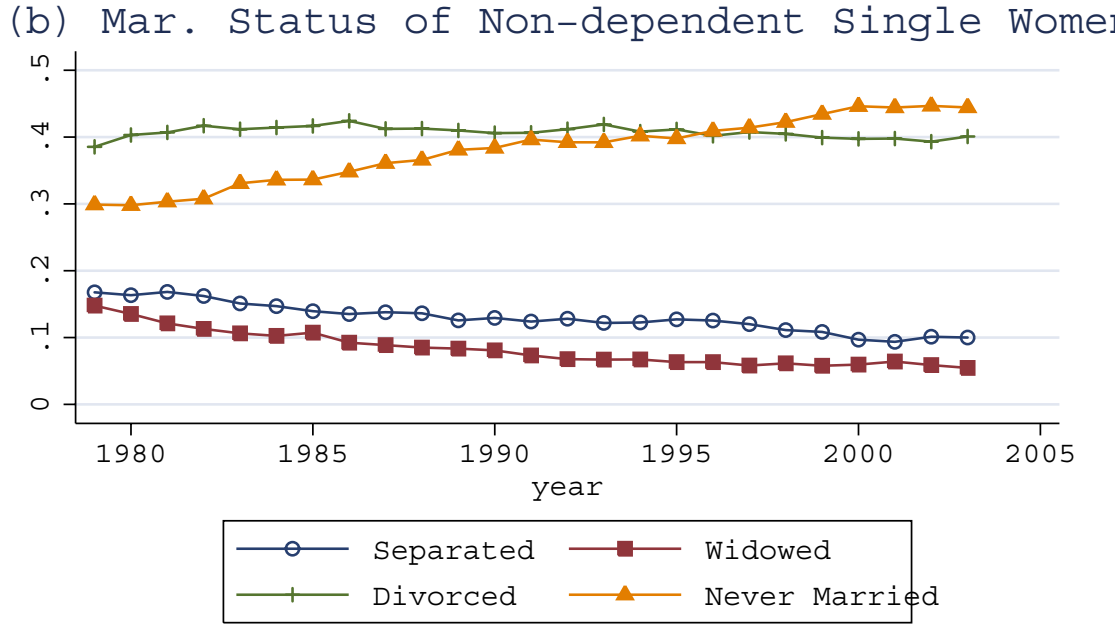
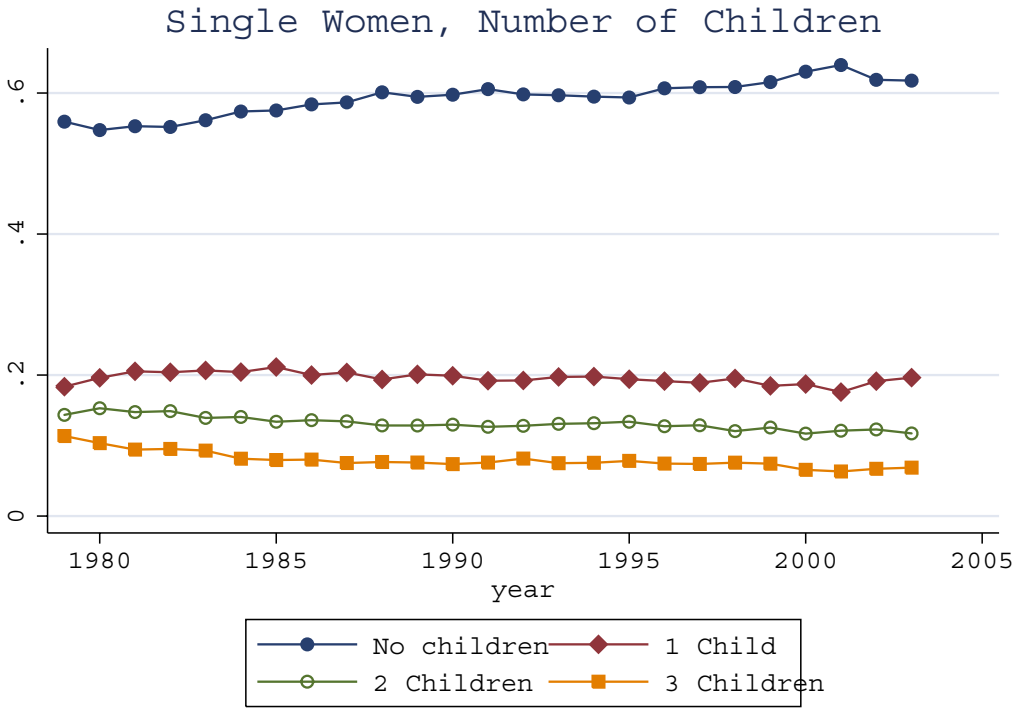


Figure 3 - Number of Children among Single Women



As can be seen from Figure 4a, the single female labor force participation rate has increased from 84% in 1979 to 92% in 2003. These labor force participation rates are significantly higher than those of married women. For example, Heim (2005) finds an increase from 63% to 79% for married women over the same time period. While the increase has not been quite as dramatic for single women, it is still substantial, and by 2003 most single women were in the labor force.

Figure 4 - Single Women's Labor Force Participation and Labor Supply

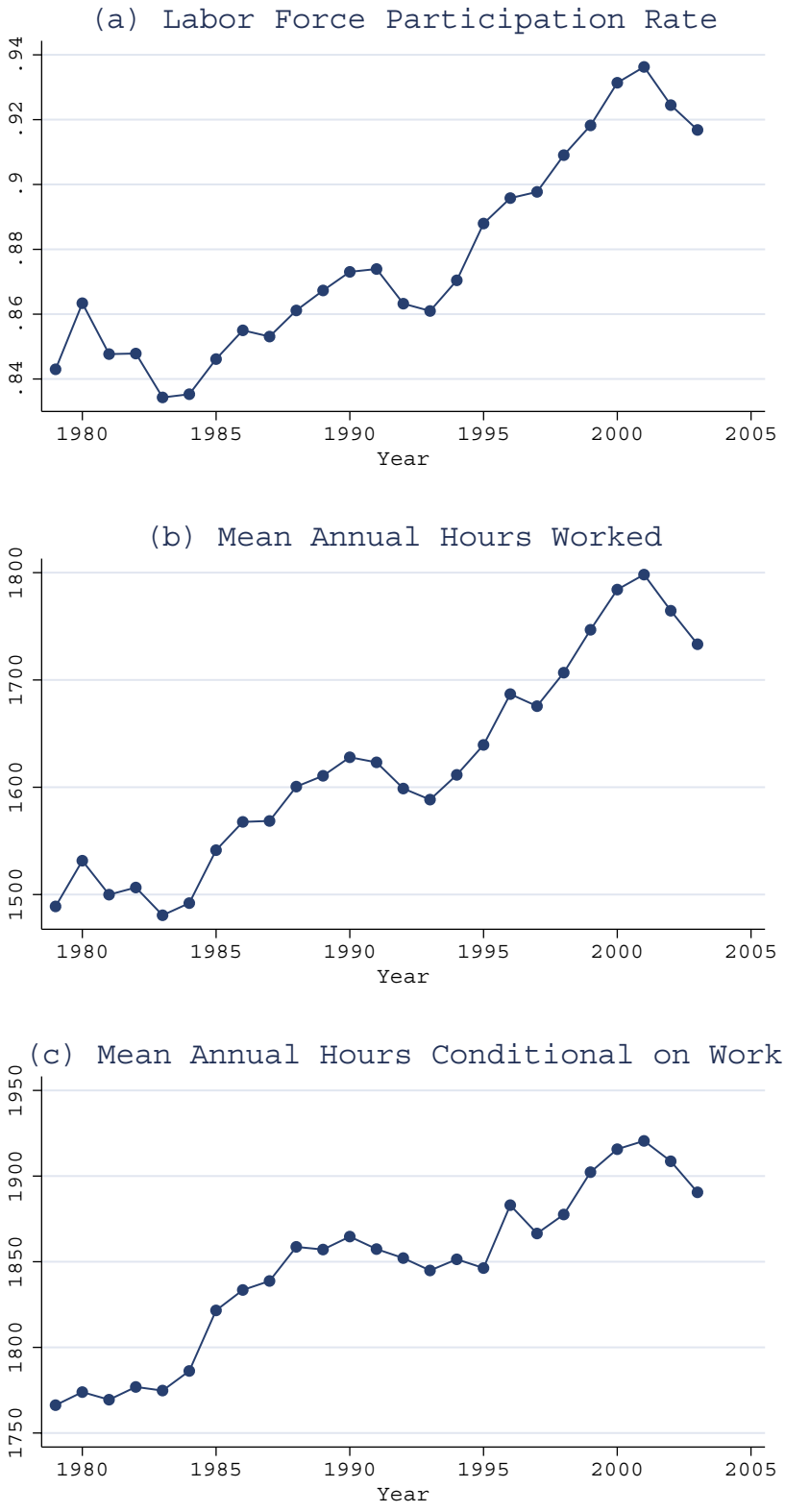


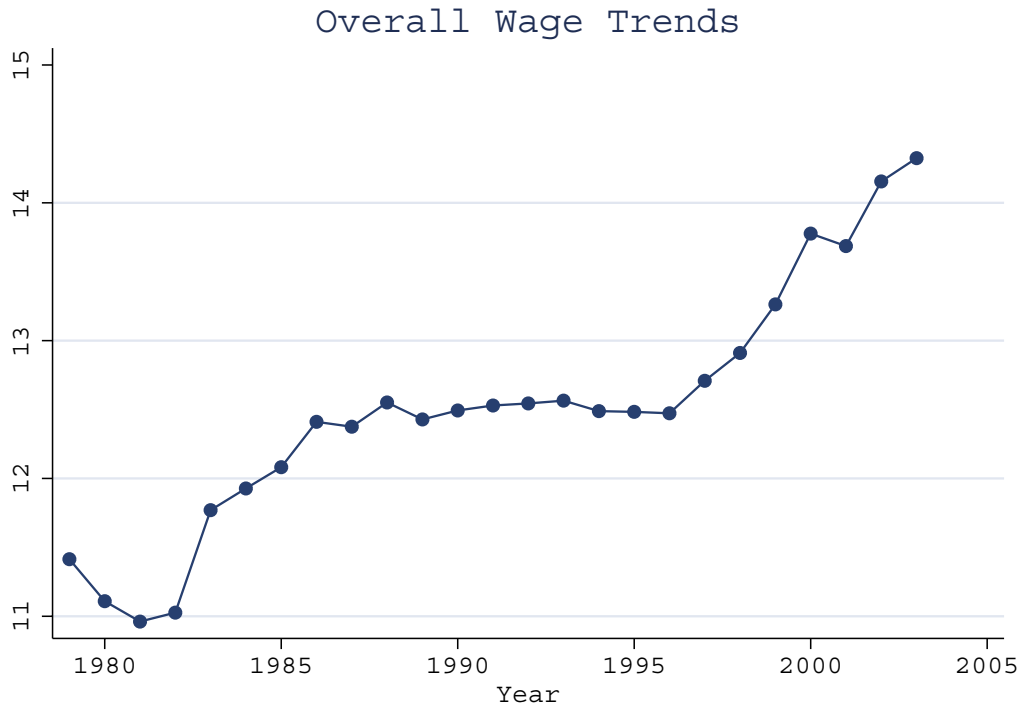
Figure 4b reports the annual hours of work for all single women, not conditional on working. Single women in 1979 worked an average of 1775 hours a year, whereas by 2003 they worked almost 1900 hours. In comparison, married women's annual hours worked increased from 915 to 1350 hours (Heim (2005)), so single women work significantly more hours.

It is interesting to note that this increase is not only due to movement along the extensive margin. In Figure 4c, annual hours of work, conditional on a woman working some hours in the year, are presented for all years in the sample. From this figure, one can see an increasing trend in annual hours even among those who are working.

Having noted the increases in labor force participation rates and labor supplies, it is interesting to examine time trends in wages. Figure 5, then, presents time trends in real wages (in 2000 dollars). In Figure 5a, we present the trend in mean real hourly wages among those single women who are working, where the wage is calculated by dividing labor income (in 2000 dollars) by hours worked. Figure 5b contains the time trend in mean real hourly wages when a direct report of the wage is used. As can be seen from both of these figures, the wages of single women have risen significantly over the past 25 years, from $11/hour in 1979 to over $14/hour in 2003.

With these changes in the marital status of women, particularly the large increase in the proportion of single women, and the changes in single women's labor supply

Figure 5 – Wages of Single Women



behavior and wages, it is clearly important for policy analysis to ascertain the extent to which single women's labor supply and labor force participation responds to changes in wages and incomes. In addition, if such responsiveness has changed over the past quarter century, it is important to make note of this change, as estimates gleaned from earlier data or using earlier policy changes to identify wage and income effects may give a misleading picture on how single women will respond to contemporaneous policy changes. It is to these recent tax and transfer policy changes to which we turn next.

3 Relevant Policy Changes 1979-2003

If single women's labor supply elasticities have followed a downward trend over the past 25 years as married women's have, we would expect the smaller elasticities to have serious implications for the effects of changes in tax and transfer programs in the US. In addition, changes in these policies may themselves be driving trends in labor supply elasticities. In this section then, we review the relevant policy changes over the past 25 years.

3.1 Recent Tax Changes

The U.S. tax system has had many significant changes over the period interest, 1979 to 2003. New tax policy has altered women's marginal tax rates directly, as in the tax reforms of 1981, 1986, 1990, 1993, 1997, and 2001, but also indirectly through the expansion of the Earned Income Tax Credit (EITC) and introduction of the Per Child Credit.[9]

[9] For a detailed description of the history of U.S. taxation, see Slemrod, J. and Bakija, J. (1996) Taxing Ourselves: A Citizen's Guide to the Debate over Taxes.

In the initial years of our sample, 1979 and 1980, Americans faced a personal income tax schedule with a low marginal rate of 14% and a high of 70% for the highest earners. The Economic Recovery Tax Act of 1981 changed this, reducing individual tax rates in all brackets to a range of 12% in the lowest bracket to 50% in the highest. In the Tax Reform Act of 1984, the lowest bracket's liability was further decreased to 11%. Congress passed another significant tax within five years, in the form of the Tax Reform Act of 1986. Again this reform was directed at individuals' marginal decisions, being a roughly revenue-neutral reformation. This act altered marginal rates, so that after its passage they ranged from a low of 15% to a high of 33%, and the personal exemption was also increased. In addition, the Tax Reform Act of 1986 expanded the Earned Income Tax Credit for low-earners from 10% to 14%, and indexed the credit for inflation. Thus, the combination of decreased tax rates and increased credits meant that over the decade of the 1980s, single women were facing increasingly lowered effective rates, and therefore increasing incentives to work.

In the 1990's however, rates began to creep up once again, particularly on those with high incomes. With the Omnibus Budget Reconciliation Act 1990, the marginal tax rate on the highest bracket increased to 31%, while a second increase in 1993 brought the top rate to 39.6 percent.

At the same time, however, the EITC was gradually expanded. In 1990, the phase-in rate of the EITC was scheduled to rise as high as 25% and the EITC became indexed for the number of dependent children. In 1993, benefits were sharply increased to include a phase-in rate of 40%, and in 1994, a modest EITC became available to the childless working poor. In addition, the Taxpayer Relief Act in 1997 created the Per

Child tax credit, which was based on the number of dependent children and was available to all single filers who earned less than $75,000 per annum.[10] In addition, the credit was refundable for low-earners and would therefore supplement the EITC.

Toward the end of our sample period, tax rates once again began to head downward. In 2001, Congress passed the Economic Growth and Tax Relief and Reconciliation Act. Although this program was being phased in over the last two years of our sample, it would clearly have affected the marginal decisions of single women. This reform lowered marginal tax rates, lowered the marriage penalty, and increased the Per Child and childcare expense credits. The marginal tax rate schedule was lowered to run from 10% to 35%, with single filers receiving a rebate check of up to $300 in the late summer of 2001. In addition, the Per Child tax credits were doubled, with the exemption per dependent child increasing from $500 to $1000.

The multiple changes in marginal tax rates, in addition to the expansion of tax credits for low income single women and single mothers, led to changing incentives over our sample period of 1979 to 2003. Were elasticities to remain at their early 1980's levels, one would expect to see single women expanding their participation with decreasing tax rates and increasing exemptions.

3.2 PRWORA and Work Incentives

The Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) was passed in 1996 in order to reform the welfare system for low-income families. The act instituted the Temporary Assistance to Needy Families Program (TANF), which replaced the existing Aid to Families with Dependent Children (AFDC)

[10] This credit was also available to joint filers who earned less than $110,000 per year

welfare program along with other programs aimed at job training and emergency assistance. As a result of these changes to the welfare programs, the incentives for single women to work were affected both at the intensive and extensive margin. Further, the labor supply behavior of single women may have changed in response to the constraints placed on these women by the new TANF program, which may in turn have affected estimated elasticities.

TANF includes work requirements for beneficiaries. Recipients must work no later than two years after coming on assistance, depending on state requirements. Single parents are required to work 30 hours per week, and two-parent families are must work 35 or 55 hours per week. Failure to meet these requirements results in the reduction or termination of benefits.

Certain financial incentives set at the state level are given to families through TANF to encourage work. Some states include earnings disregards and subsidize work expenses such as child care and transportation costs. Certain states also require signing personal responsibility agreements requiring the recipient to take steps towards self-sufficiency, while others require mandatory applicant job search and provide work related services.

Finally, TANF sets a time limit on the number of years a recipient can claim benefits. The federal limit is set to 5 years for adult recipients, but states were given the option of changing this limit. Some states chose to reduce the limits, while others opted to have no benefit limit and use state funds to extend benefits. There are also varied criteria at the state level for exempting families from the time limits.

Many of the provisions of TANF may have increased single female's labor supply by altering their incentives.[11] For example, two studies looking at the effect of waivers on labor market participation (Moffit (1999), Schoeni and Blank (2000)) found that waivers had a significant positive effect on participation, as well as on weeks and hours worked.

However, several of the provisions may have led to increased labor force participation simply because such participation was required (at some point) in order to avoid cuts in benefits. Three studies analyzing the combined effect of welfare reform with other programs[12] (Lemke et al, 1999; Queralt et al, 1999; Witte et al, 1999) found that time limits and activity requirements led to increased probability of work, but lower wages. However, these studies found that sanctions had a negligible effect on participation.

4 Data and Estimation Method

In this section we describe the data and estimation method that we use to evaluate single women's labor supply.

4.1 Sample Preparation

Data for this study come from 25 years of the March Annual Demographic Survey of the Current Population Survey, over the years 1979-2003. The Current Population Survey consists of short rotating panels, in which households are interviewed for four months, not interviewed for the subsequent eight months, then interviewed for an

[11] For a review of the economics literature analyzing the effects of PRWORA, see Blank (2002).
[12] Such as minimum wage increases and increased generosity of the EITC.

additional four months. They are then dropped from the survey. Interviews administered in the fourth and eighth months of the survey make up the Outgoing Rotation Group (ORG).

To create the sample, we include women aged 25 to 55, who were not married at the time of the survey in order to focus on labor supply behavior in the prime working years.[13] Single women are classified as those who are never married and those who are currently divorced, separated, or widowed. We also create separate cohorts for those women who are never married or divorced, as they make up the vast majority of single women.

The years 1979 to 2003 were chosen due to the availability of hourly wage variables. Respondents to the March CPS have always been asked about their usual hours of work each week and how many weeks they worked in the previous year, in addition to their labor income in the past year. Using these variables, one can create a measure of the individual's wage rate by dividing the individual's annual labor income by their annual hours of work. Indeed, such a wage measure is one of the measures used in the current study. However, labor supply equations estimated using such a wage rate are well known to suffer from division bias, biasing wage elasticities downward in absolute value.[14] In this study there is an additional concern, in that if error in reported hours of work have increased (or decreased) over the past 25 years, estimates from these years would exhibit a downward (upward) trend, even absent any real trend in behavioral parameters.

[13] Several other sample cuts are made. We exclude the self employed, as well as those who are students, retired or disabled. We exclude those for whom a valid wage measure was not available, due either to nonresponse or to topcoding. In addition, we exclude a handful of observations who report extreme wages above 200 dollars per hour or extreme transfer payments of over 25,000 per month.

[14] See, for example, Eklof and Sacklen (2000).

Starting in 1979, however, a series of questions were added for those in the Outgoing Rotation Group (ORG) of the CPS, asking for information on each individual's typical hourly or weekly wage. Since this wage measure is only available starting in 1979, it is then that we begin the timeframe of analysis. We use this variable to construct an additional hourly wage measure, and present results from both specifications. Although this wage measure has the advantage that resulting estimates will suffer from less division bias, it does not include income from second jobs or overtime work. Both of these wage variables, as well as the non-wage income are inflated or deflated to real dollars from the year 2000, using the CPI-Urban Price Index.

We cut the sample to include only those in the ORG sample when performing the estimation using the second wage measure.[15] Additional variables used in the estimation are the women's age, education, race, number of children, the presence of children under 6, as well as some geographic variables, and the unemployment rate in the state of the woman's residence.

4.2 Estimation Method

Ideally in this study, one would like to use an estimation methodology that is considered the standard way of estimating single women's labor supply. However, due

[15] Unfortunately, due to some peculiarities in the sampling frame of the March CPS in some years, not all individuals who were in the ORG received the hourly earnings questions, and these individuals are not identified in any particular way in the dataset. The major cause of this in recent years is due to the increase in the March sample used to evaluate the SCHIP program, but several other reasons exist for other years. This is a problem for those who are nonworkers, as it is impossible to tell whether or not a nonworker was part of the ORG who would have received the earnings questions had they worked. As a result, if you cut only those who were working and had a nonresponse to the ORG questions, the labor force participation rate for the resulting sample is much below the labor force participation rate of the overall sample. As such, we include in our sample all those with positive hours who have a valid response to the hourly earnings questions, and a random sample of nonworkers, so that the labor force participation rate in the resulting sample equals the labor force participation rate in the overall sample.

to the paucity of studies on single women's labor supply, no single methodology has emerged as such a method.

Indeed, even in the more voluminous married women's labor supply literature, there has not emerged a standard way of estimating labor supply. Further, many of the recent advances in this literature have either been in the estimation of structural joint labor supply models,[16] where the computational intensity makes these methods inappropriate for an analysis of 25 years of labor supply elasticities, or have relied on natural experiment variation,[17] where yearly policy changes would be needed to estimate labor supply elasticities for each year under analysis.

Fortunately, estimation of labor supply for single women is considerably simplified by the fact that, unlike estimation of married women's labor supply, one does not need to take into account the jointness of the labor supply decision between the husband and wife. Still, the lack of a standard method to use means that a choice of method must be made that may not be uncontroversial.

Thus, in this study, we employ an adaptation of the "second-generation" methods described in Killingsworth (1983) and Mroz (1987) for the estimation method, with an added fourth step that allows for the estimation of extensive-margin labor supply elasticities. This is the same method that was used in Heim (2005). As was noted there, this method has the strength that it can be estimated separately on each year of data. In addition, the identifying variation that is used to identify labor supply parameters is clear. However, such a method uses only cross sectional variation to identify labor supply

[16] See van Soest (1992), Hoynes (1996), and Heim (2005), among others.
[17] See Blundell et al. (1998).

parameters, and relies on the assumption that marital status and childbearing are exogenous.

In order to explicitly account for tax policy changes over the relevant period, we use the NBER's TAXSIM model to calculate both the tax rate and tax burden for each woman in each year at both 0 hours of work and at 40 hours of work per week. We use each woman's actual nonlabor income, including transfer payments, but set labor income to the state mean in which the woman resides. This will eliminate the endogeneity of the tax rate to the wage rate, which may be an endogenously determined variable in itself. In this step, we include taxes and EITC benefits at both the state and federal levels, and include the woman's share of the payroll tax. Finally, we assume that all women take the standard deduction.

Were we not to account for these changes, the estimated elasticities would confound behavioral parameters with tax parameters. As such, changes in the estimated elasticities could simply be driven by changes in tax rates. By controlling for tax rates in the estimation, we eliminate this possibility. However, changes in welfare policy could still affect estimated parameters. We return to this issue in Section 6.

In our setup, we assume that the labor supply behavior of single women can be described by three equations. A separate system of equations is estimated for each year of data, with *i* denoting individual and *t* denoting year.

The participation equation is described by the following:

$$P_{it}^{*} = \alpha_{0t} + \alpha_{1t} \ln W_{it}^{0} + \alpha_{2t} Y_{it}^{0} + \alpha_{3t} Z_{it}^{P} + \varepsilon_{it}^{P}$$

$$P_{it} = \begin{Bmatrix} 1 & if & P_{it}^{*} > 0 \\ 0 & otherwise & \end{Bmatrix}$$

where $P_{it} = 1$ denotes participation. In the above, W_{it}^{0} is the after-tax wage individual *i* would receive from her first hour of work, if she were to work. Y_{it} denotes her after-tax nonlabor income at zero hours of work, and Z_{it}^{p} contains other variables that affect the participation decision.

The wage equation is assumed to take the form:

$$\ln W_{it} = ß_{0t} + ß_{1t} Z_{it}^{W} + \varepsilon_{it}^{W}$$

where W_{it} denotes a woman's gross wage and Z_{it}^{W} contains variables that affect the wage.

Finally, the labor supply equation is assumed to take the form

$$h_{it} = \gamma_{0t} + \gamma_{1t} \ln W_{it}^{FT} + \gamma_{2t} Y_{it}^{FT} + \gamma_{3t} Z_{it}^{h} + \varepsilon_{it}^{h}$$

where W_{it}^{FT} denotes the woman's after tax wage if she were to work full time, Y_{it}^{FT} denotes virtual nonlabor income at this level of hours, and Z_{it}^{h} are variables other than wage and income that affect hours of work.

To jointly estimate the above equations, we employ the four-stage method described in Heim (2005). The first two stages are essentially the Heckman two-step method, with the estimation of a reduced form participation probit in the first stage and the estimation of a selection corrected wage regression in the second. In the first stage, we include as regressors the log of the net tax rate, after-tax nonlabor income at 0 hours of work, a cubic in age and years of education, race dummies, number of children, presence of children under six, unemployment rate of the state in which they reside, and geographic variables.[18] In the second, we include the cubic terms in age and years of education, race dummies, the geographic variables noted above, and the inverse Mill's

[18] The geographic variables include a dummy for whether they live in a city center, the size of the MSA in which they reside, and a dummy for the region of the US in which they live.

Ratio from the first stage probit, with nonlabor income and children variables excluded in this stage.

We then estimate a selection corrected labor supply equation in the third stage, using the imputed after-tax wage from the second stage, assuming full time hours, to instrument for reported wage. As regressors we include the previously discussed wage, nonlabor income, age, years of education, number of children, presence of children under six, unemployment and geographic variables, and the inverse Mill's Ratio from stage one. Thus, the identification of the wage coefficient comes from the exclusion of higher order terms in age and education, as well as the variation in tax rates across individuals.

With the estimates from the third stage, we are able to compute labor supply elasticities at the intensive margin. To estimate elasticities at the extensive margin, we estimate a structural participation probit model using the imputed wages from the second stage. In this case, identification of the wage coefficient comes from the exclusion of higher order terms in age and education, and variation in tax rates.

5 Overall Trends in Elasticities

In the figures that follow, estimated wage and income elasticities, both on the extensive and intensive margin, are presented.[19]

[19] Hours elasticities are calculated as

$$\varepsilon_{wt}^{h} = \frac{\hat{\gamma}_{1t}}{\overline{h}_t}$$

$$\varepsilon_{wt}^{h} = \frac{\hat{\gamma}_{2t}}{\overline{h}_t}\overline{Y}_t^{FT}$$

In Figure 6, we present elasticities estimated from the base specification described above. The points in the figure represent the actual elasticity estimates. To smooth out the trends in elasticities the results are presented two other ways. The solid line presents the results from a linear regression of the elasticity estimates against a time trend, and the dashed line represents the results from a locally weighted regression of the elasticity estimates against a time trend.

Two observations of note jump out from these figures. First, the estimated elasticities are quite small, especially compared to typical estimates of married women's labor supply elasticities. For example, the estimates of the hours wage elasticity tends to range between 0 and 0.25, and estimates of the hours income elasticity tend to fall

---

where $\hat{\gamma}_{1t}$ and $\hat{\gamma}_{2t}$ denote the estimated coefficients on log wages and nonlabor income, respectively, $\overline{h}_t$ denotes mean annual hours of work conditional on working, and $\overline{Y}_t^{FT}$ denotes mean nonlabor income. Participation elasticities are calculated as

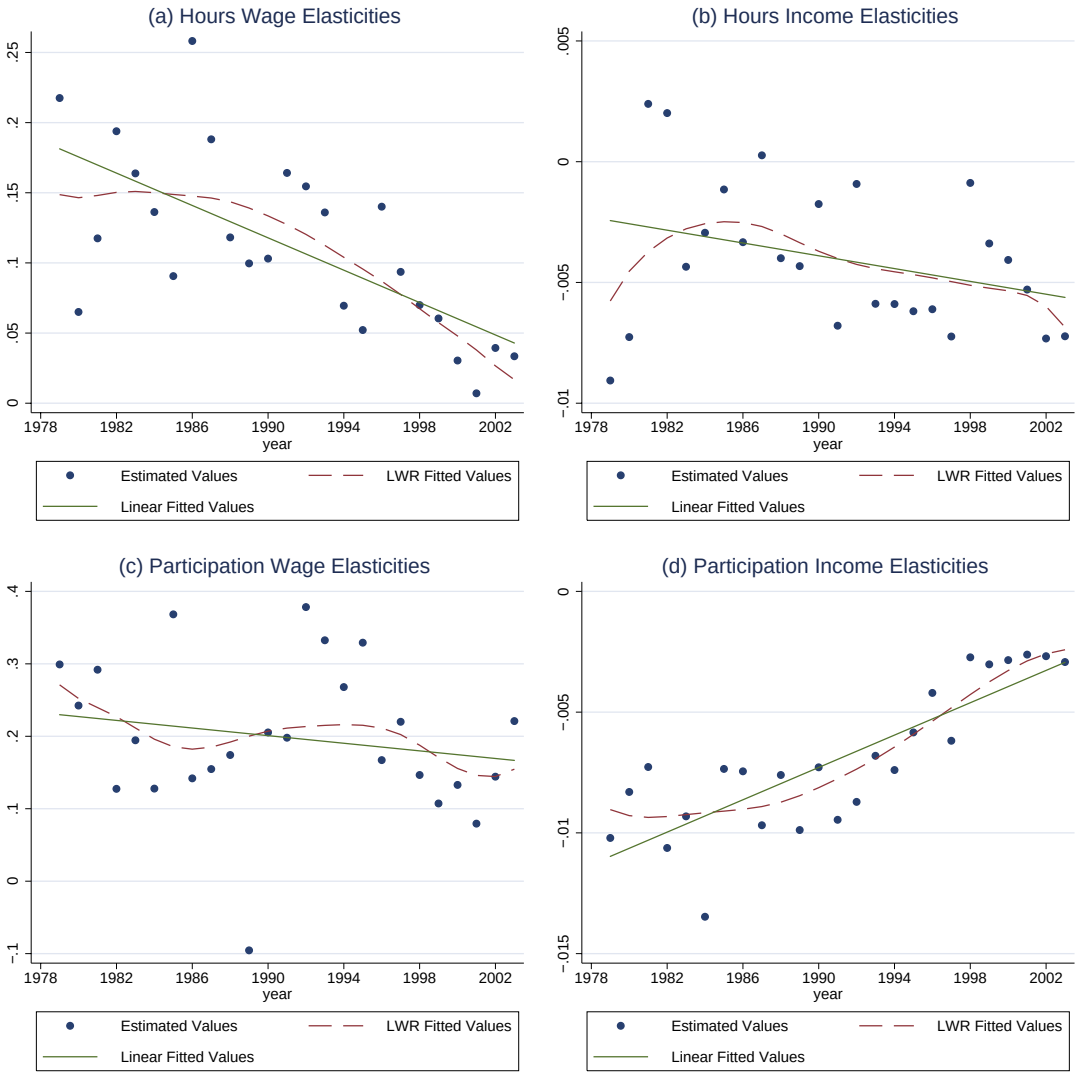
$$\varepsilon_{wt}^{p} = \frac{\overline{\frac{\partial \hat{\Phi}}{\partial \ln W_t^0}}}{lfp_t}$$

$$\varepsilon_{wt}^{p} = \frac{\overline{\frac{\partial \hat{\Phi}}{\partial \ln Y_t^0}}}{lfp_t} \overline{Y}_t^0$$

where $\frac{\partial \hat{\Phi}}{\partial \ln W_t^0}$ denotes the estimated average derivative of participation with respect to log wages, and $\frac{\partial \hat{\Phi}}{\partial \ln Y_t^0}$ denotes the estimated average derivative with respect to nonlabor income.

between -0.01 and 0. Participation wage elasticities tend to range from 0.4 to 0.08 and participation income elasticities range -0.015 to 0.[20]

Figure 6 - Estimated Single Female Labor Supply Elasticities, 1979-2003



Second, the hours wage and participation income elasticities have decreased in absolute value over the time period under analysis. The linear time trend suggests that single women's hours wage elasticities have decreased by about 67%, and the

[20] The outlier for 1989 in the participation wage elasticity figure is left out of the discussion. We were unable to determine the source of this negative number.

participation income elasticities have decreased by approximately 70%. There appears to be very little change in the hours income and participation wage elasticities. These results are further summarized in Table 1, which presents the difference in elasticities from the beginning to end of the period.

Table 1 - Differences in Elasticities [21]

Elasticity	1979	2003	|Δ|
Hours Wage	0.218* (0.057)	0.033 (0.022)	0.185* (0.061)
Hours Income	-0.009* (0.002)	-0.007* (0.001)	0.002 (0.002)
Participation Wage	0.299* (0.074)	0.221* (0.045)	0.078 (0.087)
Participation Income	-0.010* (0.002)	-0.003* (0.001)	0.007* (0.002)
Note: Author's calculations from the Current Population Survey.			

As can be seen in the above table when the beginning and ending periods of the sample are viewed in isolation, all of the labor supply elasticities decreased for single women over the 25 year period. Comparing 1979 to 2003, for instance, there was an 85% decrease in the hours wage elasticity, a 22% decrease in absolute value in the hours income elasticity, a 26% decrease in the participation wage elasticity, and a 70% absolute value decrease in the participation income elasticity. Therefore, as was seen in Figure 6, the most dramatic change occurred in the hours wage and participation income elasticities, which were also the statistically significant changes from Table 1.

Thus, from these results it appears that a change in the composition of married women cannot explain Heim's 2005 findings that married women's labor supply elasticities had fallen by substantial margins. Had each of the elasticities among single women increased substantially, this could provide a potential explanation for why

[21] The standard errors in parentheses were bootstrapped. 95% significance is denoted by *.

married women's elasticities had fallen through a sample selection story – that women with high elasticities tended to be married earlier in the early years of the sample, but these women tended to be single later in the period. However, most of the elasticities were found to be decreasing over this time period.

5.1 ORG Sample

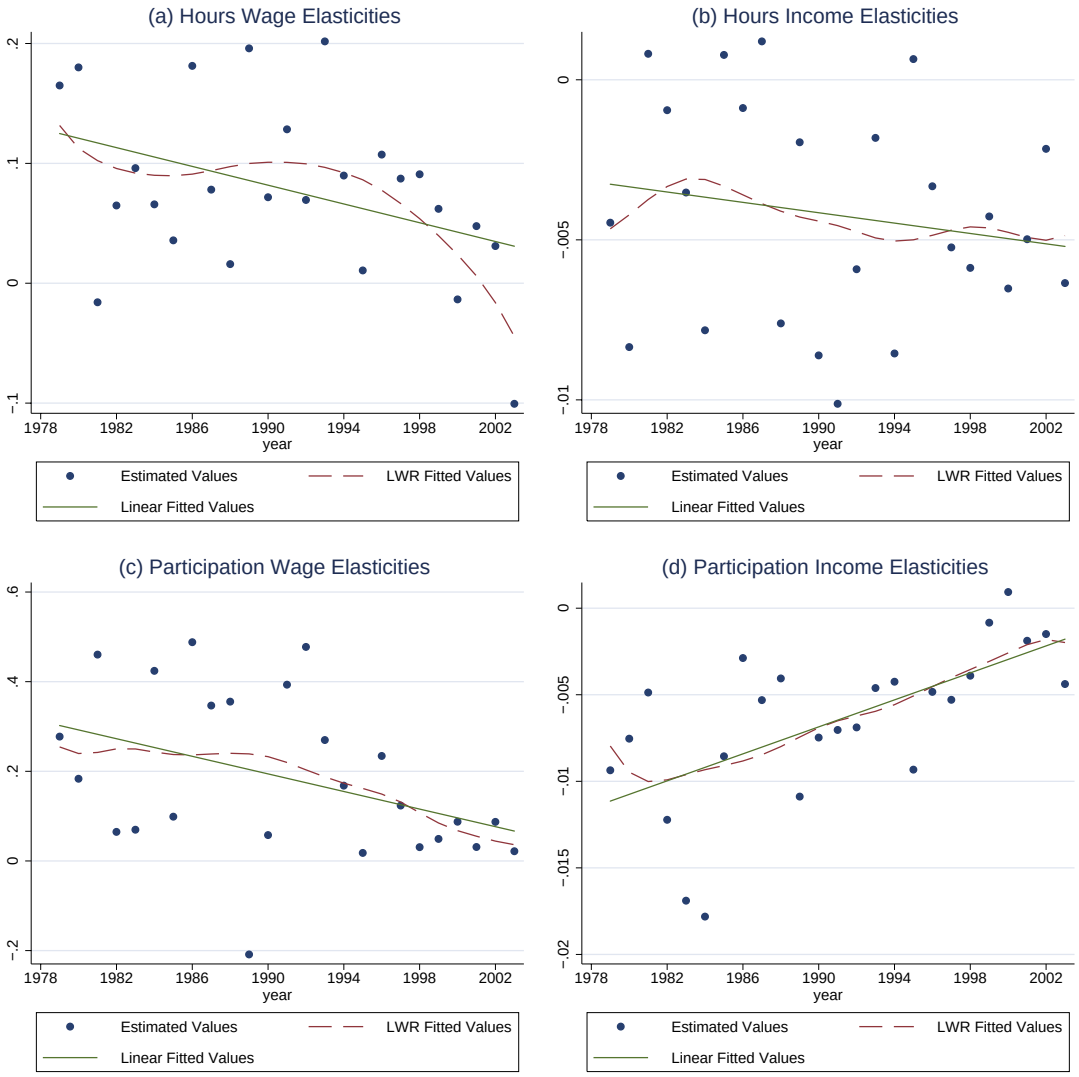
A possible explanation for the trend in elasticities is division bias that may not be completely ameliorated by the multistage estimation procedure. For example, if measurement error in hours worked decreased over the time frame covered in this study, earlier wage elasticity estimates may suffer from division bias to a greater extent than later estimates. As a result, the downward trend in elasticities could be a result of the changing division bias, and not a result of a change in the true elasticities.

To examine whether this is the case, the sample is cut to include only those who were members of the March Outgoing Rotation Group. For the women in this sample who reported their weekly wage, hourly wage was calculated as the weekly wage divided by hours per week. If no hours per week were reported, the weekly wage was divided by 40. Although, there may still exist some division bias in this method, this bias should be less in magnitude than that from the annual income divided by annual hours measure, since there are two sources of error in the annual hours measure - that from usual hours per week, and that from weeks per year.

In Figure 7, the results from the ORG specifications are presented. In this figure, panels (a), (b), and (d) look remarkable similar to those in Figure 6, though the estimates seem to be slightly noisier from year to year. However, participation wage elasticities in panel (c) now exhibit a downward trend, with a decrease of 67%. Since the trends and

magnitudes in the elasticities in Figures 6 and 7 are similar, we are able to conclude that division bias did not affect our previous estimates.

Figure 7 - Estimated Single Female Labor Supply Elasticities, 1979-2003: ORG Sample



5.2 Does the Change Differ for Different Groups?

Since there may be substantial heterogeneity in labor supply elasticities of single women based on marital history and number of children, we consider these groups separately. For example, because they have been married before, divorced women may have substantially different labor supply behavior than women that have never been married, and the trends for the two groups may move differently. Similar differences may exist between women with and without children. As a result, by pooling such groups together, we may have masked interesting trends that have been occurring at the subsample level.

Therefore, we now consider whether the changes in elasticities differ depending upon marital status and presence of children. In doing so, we can identify whether changes in elasticities among a particular subset of the population are driving the drop in the overall elasticity estimates.

5.2.1 Marital History

To examine any effects driven by the changing composition of single women, we break down our sample by marital history into four groups (never-married, divorced, widowed, and separated) and re-run the specifications. We present elasticities for the never-married and divorced cohorts, as these represent most of the single women in our data.

The results of these estimations are shown in Figures 8 and 9. From these figures, it can be seen that the elasticity measures for the never married and divorced subgroups exhibit similar trends as those from the overall sample. One exception is the participation wage elasticities of never married women, which are increasing over the sample period

and are negative in earlier years of the sample. Therefore, it appears that divorced women are driving much of the overall downward trend in participation wage elasticities.

Figure 8 - Estimated Single Female Labor Supply Elasticities, 1979-2003: Never Married Women

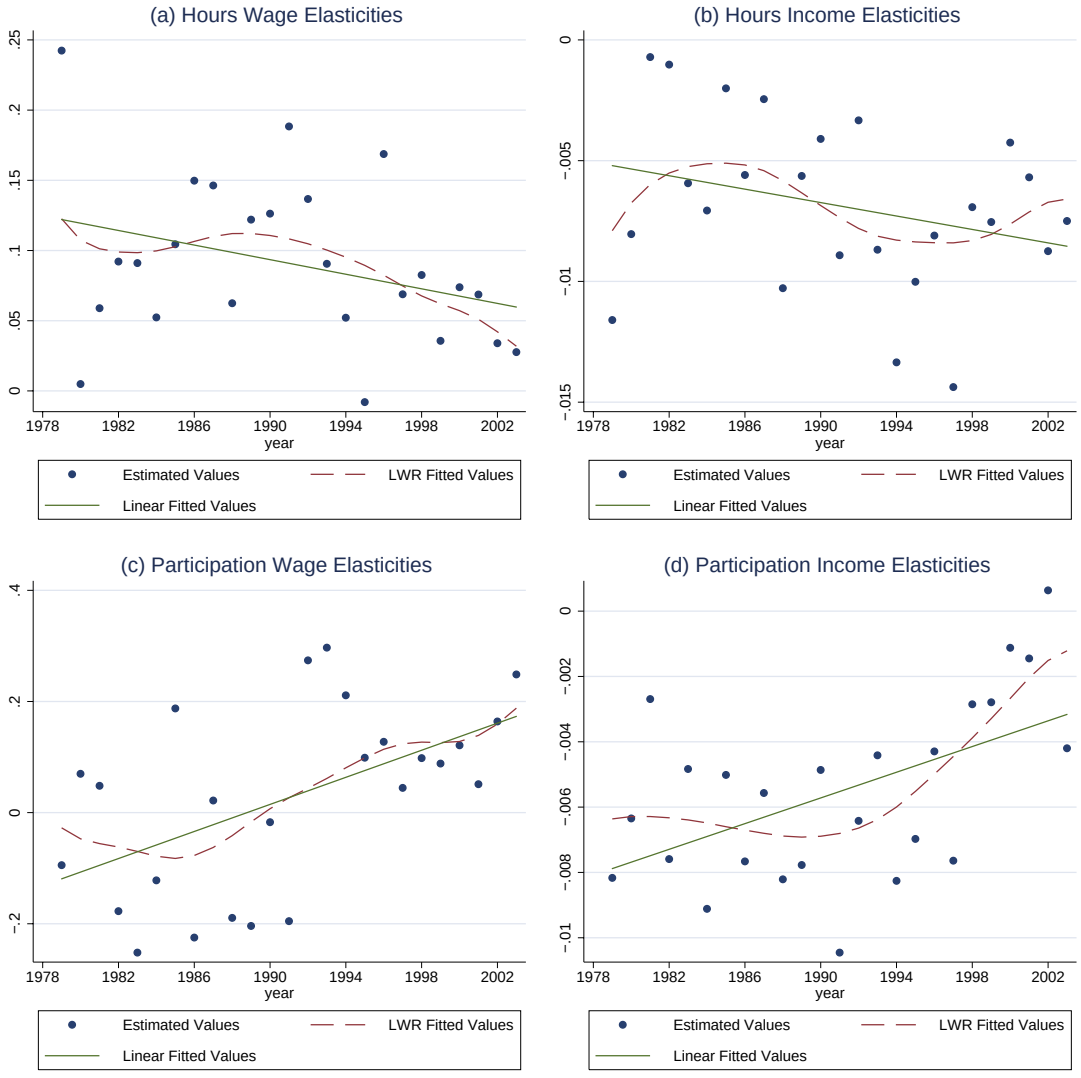
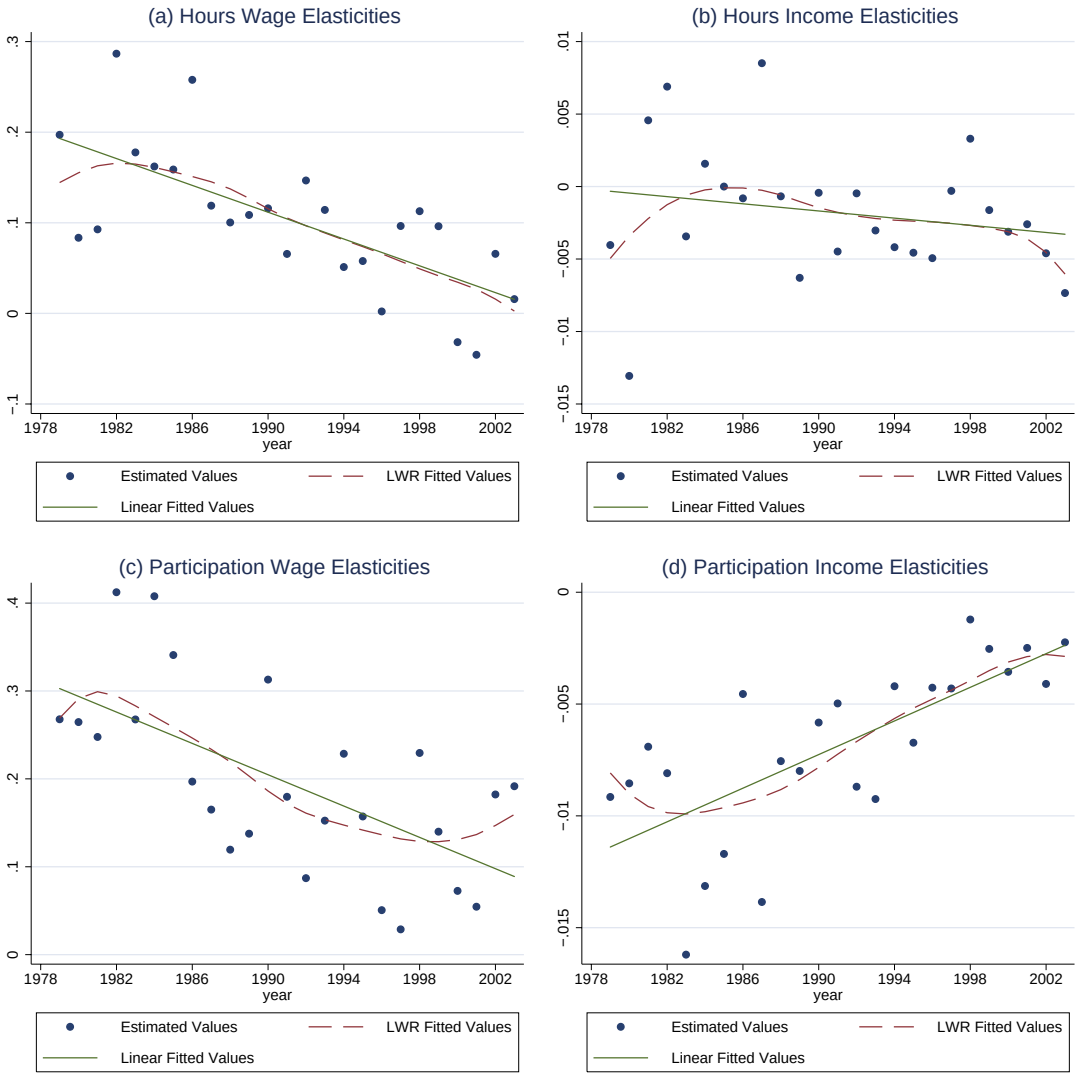


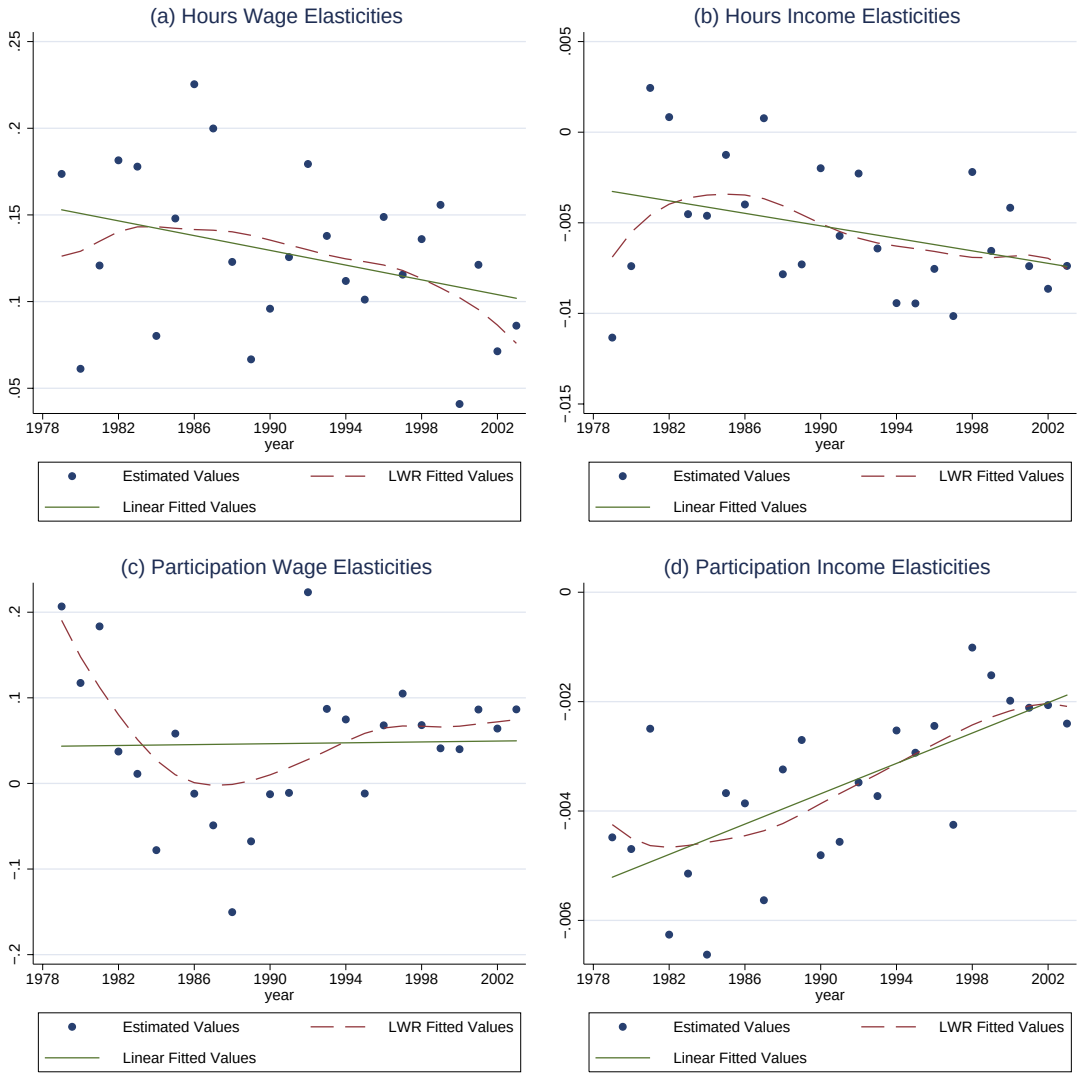
Figure 9 - Estimated Single Female Labor Supply Elasticities, 1979-2003: Divorced Women



5.2.2 Presence of Children

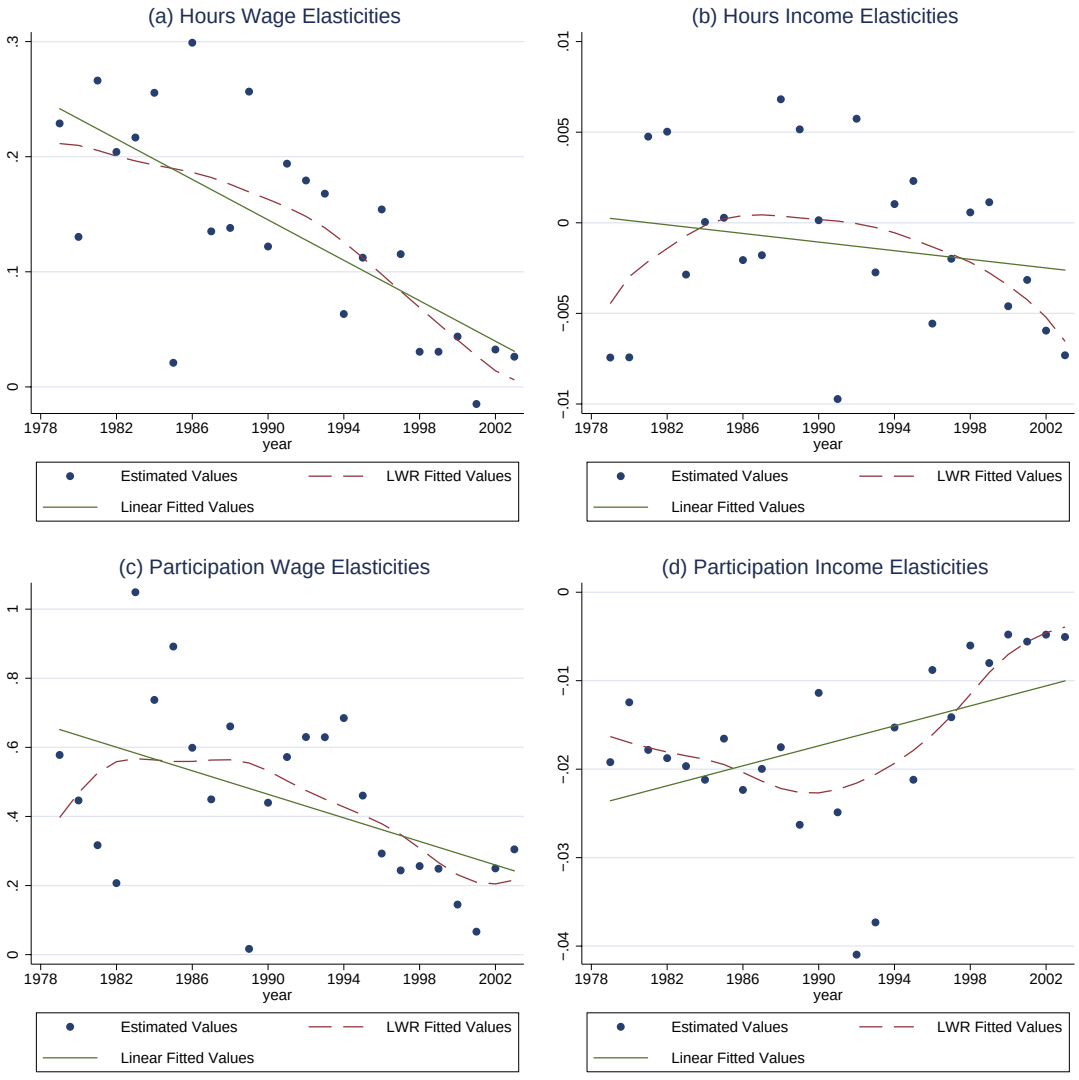
We also separately examine the effect of children on the change in elasticities. We break the sample down by presence of children and re-estimate elasticities for single women with no children and with one or more children. These results are presented in Figures 10 and 11.

Figure 10 - Estimated Single Female Labor Supply Elasticities, 1979-2003: Women with No Children



There are striking differences in the estimated hours wage elasticities across these groups. For single women with no children, we find a slight decreasing trend in hours wage elasticities. However, when we look at the cohorts with children, we find an approximately 90% drop in absolute value of the hours wage elasticity. Hours income elasticities, on the other hand, are either constant or increasing for both groups.

Figure 11 - Estimated Single Female Labor Supply Elasticities, 1979-2003: Women with Children



Turning to participation elasticities, the elasticities of single women with children exhibit a substantially larger drop than those of single women without children. For example, among women with no children, the fitted linear trend from the participation wage elasticities is constant at approximately 0.05. In contrast, among single women with children, the fitted linear trend from the participation wage elasticities was about 0.24 in 1979 and drops to 0.03 by the end of the sample period. The participation

income elasticities decreased in absolute value for both subsamples, but the drop for women with children was more substantial. Thus, it appears that decreases in elasticities among women with children have driven much of the trend in the overall sample.

5.2.3 Possible Explanations

What could have caused these labor supply elasticities to decrease so substantially over this period, particularly along the participation margin? For single women with children, one possibility is the Personal Responsibility and Work Opportunity Reconciliation Act of 1996. If PRWORA required that many of the single women with children in this sample to work regardless of their wages, this would cause participation elasticities to decrease; since if work is required of some of these women, increases or decreases in wages will not result in any change in their labor force participation.

If this were the case, one would expect elasticities to be roughly constant before 1996, and shift downward post-1996. However, looking at Figure 11, it is clear that this is not the case, particularly for wage elasticities. Rather, wage elasticities appear to be continuously decreasing over the period under analysis. Thus, it appears that PRWORA is not the primary cause of these decreasing elasticities.

In Heim (2005), a decomposition was performed to examine whether changing demographic characteristics could explain the declining elasticities, and found that such shifts explained little of the decrease. Further, sample selection into who is married clearly is not the explanation for these declining elasticities, since for that explanation to hold, elasticities would have had to increase among married women, which is not the case. Hence, determining the source of these declining elasticities is an important avenue for future research.

6 Implications of these Trends for Tax Policy

The multiple changes in marginal tax rates described in Section 3, in addition to the expansion of tax credits for low income single women and single mothers, led to changing incentives over our sample period of 1979 to 2003. Were elasticities to remain at their early 1980's levels, one would expect to see single women expanding their participation with decreasing tax rates and increasing exemptions. On the other hand, if elasticities have changed over this period, the expected effects of these changes in the tax law would depend crucially on the years in which they were implemented.

To illustrate, consider single women with children in 1979, who have income that causes them to fall in the lowest tax bracket. The estimated participation wage elasticity among these women at the beginning of the sample was approximately .65. ERTA81 caused the tax rate for these women to decrease from 14% to 12%, resulting in an increase in their after tax wage of about 2.3 percent. This, in turn, would be expected to increase labor force participation among these women by about 1.5%.

Now, consider the decrease in the lowest marginal rate that resulted form EGTRRA01. In this law, the lowest marginal tax rate decreased from 15% to 10%, so that the after tax wage increased by 5.9%. However, by this time, the estimated participation wage elasticity among single women had dropped to about .2. So, this tax change would be expected to only increase labor force participation among this sample by 1.2% percent, less than the effect of ERTA81, even though this tax change was substantially larger than the previous one.

Thus, the decrease in hours and participation elasticities over this time period suggest that future changes in tax rates should be expected to yield only a fraction of the effect of changes instituted in the 1980s.

7 Conclusion

This paper examined whether single women's labor supply elasticities, like those of married women, have decreased over the past quarter century. Results from the base specification found that hours wage elasticities and income participation elasticities have decreased by substantial percentages. When the sample is cut to only include women in the Outgoing Rotation Group and a direct report of the wage is used, the participation wage elasticity also exhibits a large decrease. However, when the sample is cut to divorced women and women with children, both the magnitude of the elasticities and the magnitude of the drop increase, suggesting that the drop in overall elasticities is driven by these subsets of single women.

These decreases in elasticities imply that changes in tax policy had a much larger effect on single mothers and divorcees in the early eighties than it has in recent years. Therefore, these results reinforce those in Heim (2005) that suggest that further cuts in marginal tax rates will not yield substantial changes in labor supply. Given the importance of labor supply elasticities in the evaluation of tax reform, identifying the source of the decrease in elasticities is clearly an important research question.

Bibliography

Altug, Sumru and Robert A. Miller. (1998). "The Effect of Work Experience on Female Wages and Labour Supply." *Review of Economic Studies*. 65:45-85.

Angrist, Joshua D. and William N. Evans. (1998). "Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size." *American Economic Review*. 88(3): 450-477.

Arellano, Manuel and Costas Meghir. (1992). "Female Labour Supply and On-the-Job Search: An Empirical Model Estimated Using Complementary Data Sets." *Review of Economic Studies*. 59:537-557.

Averett, Susan L. and Julie L. Hotchkiss. (1997). "Female Labor Supply with a Discontinuous, Nonconvex Budget Constraint: Incorporation of a Part-Time/Full-Time Wage Differential." *Review of Economics and Statistics*. 79(3):461-470.

Averett, Susan L., H. Elizabeth Peters, and Donald M. Waldman. (1997). "Tax Credits, Labor Supply, and Child Care." *Review of Economics and Statistics*. 79(1):125-135.

Blau, Francine D. and Lawrence M. Kahn. (2005) "Changes in the Labor Supply Behavior of Married Women: 1980-2000," NBER Working Papers 11230, National Bureau of Economic Research, Inc.

Blundell, Richard, Alan Duncan, and Costas Meghir. (1998). "Estimating Labor Supply Responses Using Tax Reforms." *Econometrica*. 66(4):827-861.

Blundell, Richard and Thomas MaCurdy. (1999). "Labor Supply: A Review of Alternative Approaches." in *Handbook of Labor Economics*, Volume III, ed. by O. Ashenfelter and D. Card. New York: North-Holland.

Buchmueller, Thomas C. and Robert G. Valletta. (1999). "The Effect of Health Insurance on Married Female Labor Supply." *Journal of Human Resources*. 34(1):42-70.

Christiano, L.J. and Martin Eichenbaum. (1992). "Current Real Business-Cycle Theories and Aggregate Labor-Market Fluctuation." *American Economic Review*. 82:430-450.

Cleveland, W. S. (1979). "Robust locally weighted regression and smoothing scatterplots." *Journal of the American Statistical Association*. 74:829-836.

Cogan, John F. (1980). “Married Women’s Labor Supply: A Comparison of Alternative Estimation Procedures.” in *Female Labor Supply: Theory and Estimation of Labor Supply Functions*, ed. by J. P. Smith. Princeton, N.J.: Princeton University Press.

Committee on Ways and Means. (2000). *Green Book*. Washington, DC: Government Printing Office.

Eissa, Nada and Jeffrey Liebman. (1996). "Labor Supply Response to the Earned Income Tax Credit." *Quarterly Journal of Economics*. 61:605-637.

Eklof, Matthias and Hans Sacklen. (2000). “The Hausman-MaCurdy Controversy: Why Do the Results Differ Across Studies?” *Journal of Human Resources*. 35(1):204-220.

Ellwood, David. (2000). "The Impact of the Earned Income Tax Credit and Social Policy Reforms on Work, Marriage, and Living Arrangements." *National Tax Journal*. 53(4):1063-1105.

Grogger, Jeffrey. (Forthcoming). "The Effects of Time Limits and Other Policy Changes on Welfare Use, Work, and Income Among Female-Headed Families." *Review of Economics and Statistics.*

Hansen, G.D. and W.R. Wright. (1992). “The Labor Market in Real Business Cycle Theory.” *Federal Reserve Bank of Minneapolis Quarterly Review*. Spring:2-12.

Heckman, James. (1980). “Sample Selection Bias as a Specification Error with Application to the Estimation of Labor Supply Functions.” in *Female Labor Supply: Theory and Estimation of Labor Supply Functions*, ed. by J. P. Smith. Princeton, N.J.: Princeton University Press.

Heckman, James. (1993). “What Has Been Learned About Labor Supply in the Past Twenty Years?” *American Economic Review*. 83(2):116-121.

Heim, Bradley T. (2005). “Structural Estimation of Family Labor Supply with Taxes: Estimating a Continuous Hours Model Using a Direct Utility Specification.” Duke University Working Paper.

Hotz, V. Joseph, Charles Mullin and John Karl Scholz. (2002). "The Earned Income Tax Credit and the Labor Market Participation of Families on Welfare." Mimeo, UCLA.

Hu, Wei-Yin. (1999). “Child Support, Welfare Dependency, and Women’s Labor Supply.” *Journal of Human Resources*. 34(1):71-103.

Juhn, Chinhui, Kevin M. Murphy, and Brooks Pierce. (1993). “Wage Inequality and the Rise in Returns to Skill.” *Journal of Political Economy*. 101(3):410-442.

Keane, Michael and Robert Moffitt. (1998). "A Structural Model of Multiple Welfare Program Participation and Labor Supply." *International Economic Review*. 39: 553-589.

Killingsworth, Mark R. (1983). Labor Supply. Cambridge: Cambridge University Press.

Killingsworth, Mark R. and James J. Heckman. (1986). “Female Labor Supply: A Survey.” in *Handbook of Labor Economics*, Volume I, ed by. O. Ashenfelter and R. Layard. New York: North-Holland.

Kimmel, Jean and Thomas J. Kniesner. (1998). “New Evidence on Labor Supply: Employment Versus Hours Elasticities by Sex and Marital Status.” *Journal of Monetary Economics*. 42:389-301.

Meyer, Bruce and Daniel Rosenbaum. (2000). "Making Single Mothers Work: Recent Tax and Welfare Policy and its Effects." *National Tax Journal*. 53(4):1027-1061.

Meyer, Bruce and Daniel Rosenbaum. (2001). "Welfare, the Earned Income Tax Credit, and the Labor Supply of Single Mothers." *Quarterly Journal of Economics.* 116(3):1063-1114.

Moffitt, Robert and Barbara Wolfe. (1992). “The Effect of the Medicaid Program on Welfare Participation and Labor Supply.” *Review of Economics and Statistics*. 74(4): 615-26.

Mroz, Thomas A. (1987). “The Sensitivity of an Emprical Model of Married Women’s Hours of Work to Economic and Statistical Assumptions.” *Econometrica.* 55(4):765-799.

Kydland, F.E. (1995). “Business Cycles and Aggregate Labor Market Fluctuations” in *Frontiers of Business Cycle Research,* ed by T.F. Cooley. Princeton University Press: Princeton, NJ. 126-156.

Nakamura, Alice and Masao Nakamura. (1994). “Predicting Female Labor Supply: Effects of Children and Recent Work Experience.” *Journal of Human Resources*. 9(2):304-327.

Newey, Whitney K. and Daniel McFadden. (1994). “Large Sample Estimation and Hypothesis Testing.” in *Handbook of Econometrics*, Volume IV, ed. by R.F. Engle and D.L. McFadden. New York: North-Holland.

Pencavel, John. (1998). “The Market Work Behavior and Wages of Women, 1975-94.” *Journal of Human Resources*. 33(4):771-804.

Slemrod, Joel and Jon Bakija, (1996) *Taxing Ourselves: A Citizen’s Guide to the Great Debate over Tax Reform*, MIT Press: Cambridge.

Winkler, Anne E. (1991). “The Incentive Effects of Medicaid on Women’s Labor Supply.” *Journal of Human Resources*. 26(2):308-337.

Woittiez, Isolde and Arie Kapteyn. (1998). “Social Interactions and Habit Formation in a Model of Female Labor Supply.” *Journal of Public Economics*. 70:185-205.