FAMILY COMPOSITION AND MARGINAL TAX RATES: AN IDENTIFICATION STRATEGY FOR ESTIMATING INTERTEMPORAL LABOR SUPPLY SUBSTITUTION

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THE INTERTEMPORAL ELASTICITY OF LABOR supply is a central parameter determining how individuals allocate labor supply over the lifecycle, how Social Security programs influence labor supply and retirement decisions, and how shocks to productivity translate into aggregate employment and output fluctuations. There remains considerable uncertainty, however, regarding the magnitude of intertemporal labor substitution, with some empirical studies finding no evidence of substitution over time and others finding significant substitution.

One issue in the empirical estimation of the intertemporal elasticity of labor supply is the lack of appropriate instruments for intertemporal wage changes. Much of the existing literature has used age and education related variables as instruments for lifecycle wage changes (see, for example, Altonji, 1986). These measures, however, are potentially correlated with changes in tastes. Furthermore, Mroz (1987) notes that these estimates are often sensitive to the choice of instruments.

More recent work by Mulligan (1999) exploits the "natural experiment" created by eligibility rules for Aid to Families with Dependent Children (AFDC). A family's AFDC eligibility ends on their youngest child's 18th birthday, and as a result recipients face an anticipated change in their net-of-benefit wage at that time. Mulligan examines the labor supply of welfare recipients around that time and finds large intertemporal elasticities.

In this paper, we revisit Mulligan's (1999) AFDC experiment using data on AFDC recipients from the Survey of Income and Program Participation (SIPP). We replicate Mulligan's results, but find evidence suggesting that his results should be interpreted as mean reversion rather than intertemporal labor supply changes. We do find support for a central identifying assumption: anticipated lump-sum income changes appear to have no effect on intertemporal labor supply.

We propose an alternative estimation strategy that exploits variation in federal marginal tax rates arising from anticipated changes in family composition. Some child-related tax benefits are tied to the number and ages of dependent children and have economically significant implications for marginal tax rates. We show that changes in the ages of children can result in anticipated changes in marginal tax rates and, therefore, net-of-tax wages, providing an identification strategy for estimating intertemporal labor supply elasticities. We then examine a variety of specific tax provisions, including the dependent exemption, the earned income tax credit, the child tax credit, the HOPE and Lifetime Learning credits, the dependent and childcare credit, the student loan interest deduction, and the exemption phase-out. We demonstrate the advantages of exploiting this type of tax rate variation relative to the strategies used in the existing literature on intertemporal labor supply.

LITERATURE

The traditional lifecycle labor supply model assumes that individuals maximize an intertemporally separable utility function subject to intertemporal and lifetime budget constraints. Finding the first order conditions and taking a log-linear approximation gives the following Frisch labor supply equation (for a complete derivation see Blundell and MaCurdy, 1999):

$$\Delta\ln(l_{it}) = \Delta\alpha_{it} + \gamma\Delta\ln(w_{it}) - \delta(r_{it} - \rho) + \delta\Phi_{it} + \delta\varepsilon_{it}$$

where $\Delta\ln(l_{it})$ is the change in log labor supply, $\Delta\alpha_{it}$ is changes in tastes, $\delta(r_{it} - \rho)$ denotes differences in the rate of time preference and the interest rate, and ε_{it} is a disturbance term. Φ_{it} denotes the difference between expected and actual marginal utility of wealth; $\Phi_{it} = [\ln(\lambda_{it}) - E_{it-1}(\ln(\lambda_{it}))]$ where λ_{it} is the Lagrange multiplier or the marginal utility of income.

Many studies control for various covariates to proxy for changes in tastes, assume perfect capital markets, and perfect foresight, and allo-

cate $\delta\Phi_{it}$ to the error term. If individuals cannot smooth consumption over time by borrowing or saving, or if wage changes are unanticipated and lead to permanent changes in lifetime wealth, it is unlikely that $E[\ln(\lambda_{it}) - E_{it-1}(\ln(\lambda_{it}))] = 0$, i.e. that the marginal utility of wealth is not affected by the wage change.

This is problematic when using tax reforms or other unanticipated wage changes to estimate intertemporal labor supply because these changes also affect permanent income. If leisure is a normal good, mixing income and substitution effects will generally bias elasticity estimates downward.

Researchers have tried to overcome these issues by using instrumental variables strategies and natural experiments. It is difficult, however, to find exogenous wage changes that do not change expected lifetime wealth. The past literature has used age and education related variables as instruments for lifecycle wage changes, but these are unlikely to be exogenous to changes in tastes and, therefore, do not satisfy the exclusion restriction and, furthermore, have been shown to be sensitive to the choice of instruments (Mroz 1987).

In response to these difficulties, Mulligan (1999) examined the labor supply response of AFDC[1] recipients to a fully anticipated change in wages: the termination of AFDC benefits when the recipient's youngest child turns 18. Using data from the Panel Study of Income Dynamics (PSID), Mulligan compared the labor supply of mothers on welfare when their youngest child is 15 and when the child is 19. The termination of AFDC benefits on the childs 18th birthday results in a decrease in the implicit tax on earnings for these women; AFDC benefits were reduced by roughly $.33 for each $1 of earnings so that the end of eligibility precipitated an increase in their effective wage of close to 50 percent. He found that women who were AFDC recipients increased their labor supply, while non-AFDC women, who experience no change in implicit tax rates, did not change labor supply. Table 1 shows the Mulligan results; the estimates imply elasticities between 0.38 and 1.66.

REVISITING MULLIGAN'S AFDC EXPERIMENT

We revisit the Mulligan experiment using data from the 1990-1996 panels of the Survey of Income and Program Participation (SIPP). The SIPP data are an improvement over the PSID data Mulligan uses; sample sizes are larger (20,000-

Table 1
Mulligan AFDC Results

	(1) Non-AFDC	*(2) AFDC*	*(3) AFDC Female Heads*	*(4) AFDC Female Heads afdc19=0*	*(5) AFDC Female Heads afdc19=0 hdage<62*
Before (age 15)					
Fraction hours>0	0.69	0.30	0.28	0.32	0.35
Annualized hours	1051	348	314	382	387
After (age 19)					
Fraction hours>0	0.67	0.33	0.34	0.38	0.43
Annualized hours	1090	422	406	486	560
Difference					
Fraction hours>0	–0.02	0.03	0.06	0.06	0.08
%	**–0.03**	**0.10**	0.19	0.17	0.21
Annualized hours	39.00	74.00	92.00	104.00	173.00
%	**0.04**	**0.19**	0.26	0.24	0.37
Observations	1622	79	65	53	46

Source: Mulligan, 1999, Table 4.

Notes: Emphasis added. Column 3 restricts the sample of AFDC households to female headed households; Column 4 further restricts the sample to those not on AFDC in the post-period; Column 5 further restricts the sample to households in which the household head is younger than 62. See Mulligan for details.

45,000 households), information is collected at four-month intervals, which reduces measurement and recall error, and the sample is designed to measure precisely welfare participation, employment, and income at the monthly level. In addition, the detailed demographic information includes month and year of birth, so that we can identify the exact month when a family's AFDC eligibility ends. In our analysis, we focus on changes in labor supply of mothers as their youngest children age from 17.5 to 18.5.

Our initial results are very similar to Mulligan (1999). We find virtually no change in the share of non-AFDC mothers working, whereas the share of AFDC mothers working increases by 10 percentage points (80 percent; see Table 2, columns (1) and (2). Interpreting this simple difference in outcomes as the response to the differences in the work incentives faced by each group suggests a large intertemporal labor supply response.

A potential concern with this comparison is that non-AFDC women may not be a good control group for AFDC women. We, therefore, consider two alternative control groups: AFDC women whose youngest children age from 16.5 to 17.5 and AFDC women whose second-youngest children age from 17.5 to 18.5. This first control group remains eligible for AFDC and should not anticipate or experience any change in their net-of-AFDC wage. The second control group experiences a decrease in the level of benefits of about 20 percent on average because they go from having two qualifying children to having one qualifying child. Their remaining benefits are reduced at the same rate as earnings increase, so there is no change in the implicit tax rate.

Columns (3) and (4) of Table 2 show that changes in labor supply for these control groups are very similar to the original treatment group. The share of mothers working increases by 14 percentage points (89 percent) for the first control group and by 9 percentage points (43 percent) for the second control group. We find similar patterns for hours worked. These results indicate that the observed effects can be more readily explained by mean reversion (mothers on AFDC are being observed at a time when earnings are unusually low) than by intertemporal substitution.

One additional prediction of the lifecycle model of intertemporal labor supply is that anticipated lump-sum changes in income should have no consequences for labor supply. We do find suggestive evidence that income effects, if any, are likely to be small: the second control group experiences a

Table 2
Reanalyzing the Mulligan AFDC Experiment

	(1) NonAFDC Youngest child (17.5-18.5)	*(2) Treatment Youngest child (17.5-18.5)*	*(3) Control 1 Youngest child (16.5-17.5)*	*(4) Control 2 2nd youngest child (17.5-18.5)*
Before				
AFDC>0	0	1	1	1
Fraction hours>0	0.76	0.12	0.16	0.22
Annualized hours	1419.9	159.5	202.3	317.9
After				
AFDC>0	0	0.29	0.72	0.68
Fraction hours>0	0.76	0.22	0.30	0.31
Annualized hours	1433	340.7	452.4	434.6
Difference				
AFDC	0	–0.71	–0.28	–0.32
Fraction hours>0	0.00	0.10	0.14	0.09
In %	0	80	89	43
Annualized hours	13.1	181.2	250.1	116.7
In %	1	114	124	37
Observations	1643	41	57	65

Source: 1990-1996 SIPP panels; authors' calculations.

substantial reduction in income and no change in tax rates, but exhibits changes in labor supply that are actually smaller than those of the original treatment group and the first control group.

ESTIMATING INTERTEMPORAL LABOR SUPPLY SUBSTITUTION USING ANTICIPATED TAX CHANGES

We propose an empirical methodology that uses anticipated tax changes associated with changes in family composition to instrument for intertemporal changes in the net-of-tax wage rate. Parents may claim tax credits and dependent exemptions for their children that are tied to children's ages either explicitly or because they depend on a child's enrollment in post-secondary schooling. Changes in the ages of children can thus change parents' marginal tax rates by shifting individuals across tax brackets or through phase-in or phase-out provisions of tax credits. The aging of children can, therefore, provide an exogenous source of variation with which to instrument for actual marginal tax rate changes.

This strategy has several advantages for estimating intertemporal substitution. First, these tax changes create changes in net-of-tax wages that are exogenous to the individual and anticipated in advance. Marginal tax rates have long been used in the empirical literature in public finance and labor economics to estimate static labor supply elasticities. For example, Eissa (1995) and Eissa and Liebman (1996) use tax rate changes to examine labor supply decisions of high income married women and EITC recipients, respectively. In a static setting, tax policy changes are assumed to have no lifecycle consequences, but this assumption may not be valid if policy changes affect life-time income.

Our approach differs because the marginal tax rate changes we examine can be anticipated in advance, implying that these changes should not precipitate reevaluations of lifetime income. Using anticipated tax changes allows us to estimate compensated elasticities that are uncounfounded by lifecycle wealth effects.

Second, the primary determinant of the timing and magnitude of the wage changes is the ages of the children in the family rather than factors related to the labor market that might affect labor supply through other channels. Therefore, there should be less concern that any response is being driven by unobserved labor market conditions.

Similarly, tax policy changes may be endogenous to economic conditions. For example, policymakers have lobbied for tax cuts to spur economic growth in times of economic hardship. Because our strategy examines changes in marginal tax rates that are independent of changes in tax policy, this is unlikely to be a source of bias.

Third, the tax rate changes we identify can differentially affect families with similar income and demographic characteristics. Many previous estimates of the effects of taxes on labor supply use "differences-in-differences" estimators that rely on comparisons of different income groups. These comparisons can be problematic if incomes of the different groups grow differentially over time, as during the growth in inequality over the 1980s. This problem can be addressed directly by our empirical approach because the tax changes we examine affect specific groups depending on their income and the ages of their children. This allows us to create "control groups" with very similar incomes or with identical family structures.

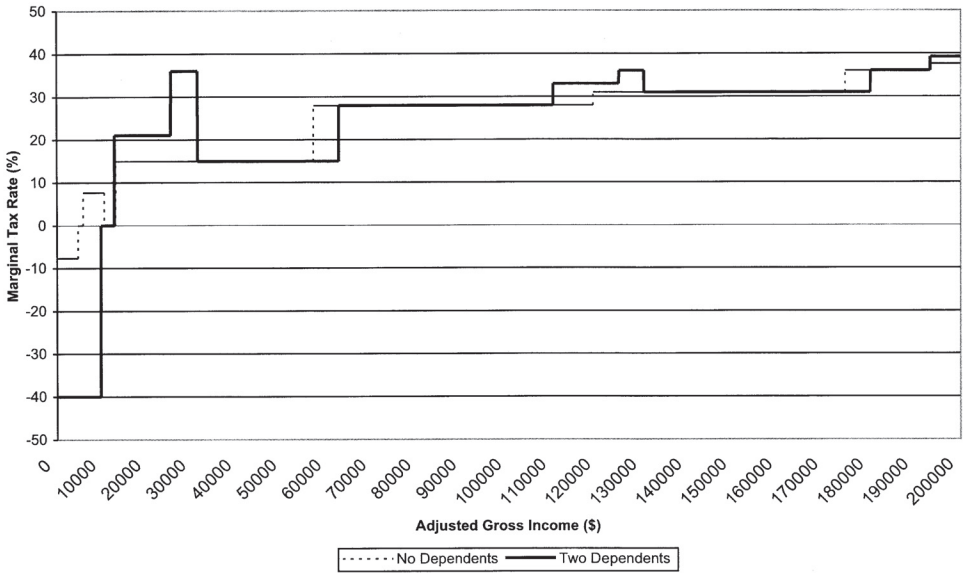
CHILD-RELATED INCOME TAX PROVISIONS AND INTERTEMPORAL WAGE CHANGES

Child-related tax benefits affect marginal tax rates in a number of ways. Figure 1 illustrates the differences in federal marginal tax rates faced by married couples with two dependents and those with no dependents. The figure illustrates how changes in the number of children affects marginal tax rates. At the lower end of the income distribution, the EITC phase-in and phase-out ranges have large effects on marginal tax rates. Between $55,000 and $65,000 of AGI, the dependent exemption can shift taxpayers between the 15 percent and 28 percent tax brackets. Around $110,000, the child tax credit phase-out increases marginal tax rates by 5 percentage points for families with children under 17. In addition, the dependent and child care credit, the Hope and Lifetime learning credits, the student loan interest deduction, and the exemption phase-out are all related to a child's age and/or post-secondary school attendance and affect marginal tax rates. These are discussed in detail below.

Dependent Exemption

Increases in the number of dependents reduce taxable income (by $3,050 in 2003), thereby pushing bracket "kink" points to higher levels of AGI.

Figure 1: **Federal Marginal Tax Rates for Married Couples by AGI and Number of Dependents (2000)**



This is particularly apparent in Figure 1 for families with AGI between $56,000 and $63,000, where families move between the 15 percent bracket and the 28 percent bracket. These families face an almost doubling of their marginal tax rate when a child no longer qualifies as a dependent, either by turning 24 or by turning 19 and not pursuing full time post-secondary schooling.

Earned Income Tax Credit

The Earned Income Tax Credit (EITC) provides a refundable credit to low-income earners. A small subsidy exists for very-low earning individuals with no dependents (up to $382 in 2003 for those earning less than $11,230), but the subsidy is more substantial for parents with one or more children. For parents, the EITC phases-in at a 40 percent subsidy rate (34 percent for parents with one child) up to a maximum credit of $4,204 ($2,547) at $10,510 ($7,490), and phases-out at a 21.06 percent rate (15.98 percent) starting at $13,730. Parents in the phase-in and phase-out ranges of the credit experience significant marginal tax rate changes when their children may no longer be claimed as dependents. For example, a family with earnings of $20,000 and one child would see their marginal tax rate fall from 26 percent to 10 percent when their child turned 19.

Child Tax Credit

The Child Tax Credit currently provides a $1,000 credit for each child under 17. The credit is phased-out at 5 percent for single filers starting at $75,000 and for joint filers at $110,000. Two credits do not create 10 percent marginal tax rates; they simply extend the 5 percent phase-out range. Parents with incomes in the phase-out range face 5 percentage point reductions in their marginal tax rates when a child turns 17.

HOPE and Lifetime Learning Credits

The Tax Reform Act of 1997 introduced two major tax incentives for higher education: the HOPE credit and the Lifetime Learning Credit (LLC). The HOPE credit is a nonrefundable tax credit that can be used by families to offset expenses for students claimed as dependents in the first two years of post-secondary education equal to 100 percent of the first $1,000 of net tuition and fees and 50 percent of the next $1,000. The LLC is a nonrefundable credit available to anyone enrolled in a post-secondary educational institution and provides taxpayers with a credit of 20 percent of the first $5,000 of net tuition and fees.

The HOPE credit is available on a per-student basis (maximum credit per student is $1,500), and a family can claim more than one HOPE recipient

in a given year. The LLC is available on a per-taxpayer basis (maximum credit per family is $1,000). It is not possible to claim both a HOPE credit and LLC for the same student. It would be possible, however, for a family with two children, a college freshman and junior, to claim both a HOPE credit and an LLC.

Both the HOPE credit and the Lifetime Learning Credit are phased out for single filers between $40,000 and $50,000 of modified AGI [2] and for joint filers between $80,000 and $100,000 of modified AGI (indexed after 2001) regardless of the number of credits claimed by the family, resulting in very large potential increases in marginal tax rates for eligible families in the phase-out ranges: the LLC phase-out raises marginal tax rates by up to 5 percentage points for joint filers and 10 percentage points for single filers. For families with a single HOPE credit recipient, marginal tax rates are increased by up to 7.5 percentage points over the relevant income range; for single-parent families, the increase can be 15 percentage points. For taxpayers with multiple beneficiaries, the effects can be even more dramatic. A single parent family with two HOPE credit recipients could face an increase in its marginal tax rate of up to 30 percentage points ($3,000 in credits over $10,000 of income). Families with college-aged children with income at or near the phase-out ranges of these credits experience significant but temporary changes in their net-of-tax rates when their children attend college.

Other Child-Related Tax Provisions

In addition, other child-related tax benefits have marginal tax rate implications. The dependent exemption phase-out, dependent and child-care credit phase-out, and the student loan interest deduction phase-out (which are all tied to children's ages or post-secondary schooling) raise marginal tax rates by between .8 to 4.2 percentage points.

CONCLUSION

Economists' understanding of the magnitude and empirical importance of intertemporal labor supply remains underdeveloped in part because of difficulties identifying exogenous but anticipated intertemporal wage changes. This paper reexamines one piece of evidence on intertemporal labor supply and develops a new strategy for extending the empirical literature.

We examine features of the federal tax code that depend on the number, age, and educational enrollment of a taxpayer's children and that have marginal tax rate implications. These features create exogenous changes in a taxpayer's net-of-tax rate that are anticipated in advance. We demonstrate how these tax changes can be used to estimate the elasticity of intertemporal labor supply.

Notes

[1] Prior to 1996, welfare was commonly known as Aid to Families with Dependent Children or AFDC.

[2] The income base on which the credits are calculated is modified AGI. This is equal to AGI plus excluded income earned abroad.

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