

# Tax Reform and Automatic Stabilization

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## Abstract

A fundamental property of a progressive income tax is that it provides implicit insurance against shocks to income by dampening the variability of disposable income and consumption. The Economic Recovery Tax Act of 1981 (ERTA) and the Tax Reform Act of 1986 (TRA86) greatly reduced the number of marginal tax brackets and the maximum marginal rate, which limits the stabilizing effect of the tax system on household consumption when pre-tax income fluctuates. We examine the effect of the federal income tax reforms of the 1980s on the associated degree of automatic stabilization of consumption. The empirical framework derives from the consumption insurance literature where the ideal outcome is spatially equal changes in households' marginal utilities of consumption. Because evidence for U.S. households rejects complete consumption insurance we begin with a model of partial consumption insurance, which we use to identify how the degree of partial insurance has changed since ERTA and TRA86. Our data come from interview years 1980–1991 in the Panel Study of Income Dynamics. We find that in certain cases the tax reforms of the 1980s actually increased the automatic stabilization inherent in a progressive income tax (especially when the Social Security payroll tax and the Earned Income Tax Credit are included). Overall, though, ERTA and TRA86 reduced consumption stability by about 50 percent. More recent tax reforms, most notably increased EITC generosity, have restored or enhanced consumption insurance.

**Keywords:** Consumption Insurance, Automatic Stabilizers, Progressive Income Taxes, Earned Income Tax Credit, Forward-Filter Estimator

One of the most important economic events of the 1980s was the comprehensive overhaul of the U.S. federal income tax system. The Economic Recovery Tax Act of 1981 (ERTA) reduced marginal tax rates an average of 23 percent within each bracket. The Tax Reform Act of 1986 (TRA86) broadened the tax base and reduced the number of tax brackets from 16 to two. The top marginal tax rate dropped from 70 percent in 1981 to 50 percent in 1982 and dropped further to 28 percent in 1988. In 1980 over 75 percent of taxpayers faced statutory tax rates above 15 percent; by 1995 less than 25 percent faced rates above 15 percent (Burman et al. 1998). Overall, the tax reforms in the 1980s reduced the average tax burden by 25 percent. Many economists have examined how tax reform influenced incentives to work (Blundell et al. 1998, Bosworth and Burtless 1992, Eissa 1996, Kniesner and Ziliak 1998, Ziliak and Kniesner 1999), to save (Bernheim 1999, Bosworth and Burtless 1992, Engen and Gale 1996), and to invest (Auerbach 1996, Auerbach and Slemrod 1997). Conspicuously absent is research on how the tax reforms of the 1980s offset a beneficial dimension of progressive taxation, the so-called automatic stabilizer. We examine empirically how the reforms to the federal income tax in the United States during the 1980s reduced the automatic smoothing of household disposable income and consumption after a shock to income.

The lack of research on automatic stabilization is somewhat surprising because of the parallel literature on the consumption smoothing benefits of social insurance programs (Hamermesh 1982; Gruber 1996, 1997; Dynarski and Gruber 1997) and because a key function of a progressive income tax is to provide collective insurance against idiosyncratic shocks to income and in turn smooth consumption and dampen the business cycle. In the face of a negative shock to taxable income, consumption is reduced

by less because the tax burden is reduced as the household falls into a lower marginal tax bracket. With lower tax rates and fewer and wider marginal tax brackets under ERTA and TRA86 the likelihood of falling into a lower tax bracket after a negative shock to income is diminished, which limits households' ability to maintain consumption. Contrary to the welfare-enhancing effects of the flattening of the income tax in the 1980s operating through the labor-supply substitution effect (Hausman 1981, Kniesner and Ziliak 1998), a weakened automatic stabilizer is welfare-reducing because households have greater variability of disposable incomes (Varian 1980).

There is substantial empirical research on how actions within families (Hayashi, Altonji, and Kotlikoff 1996) and between families (Altug and Miller 1990, Attanasio and Davis 1996, Banks et al. 1997, Cochrane 1991, Deaton 1997, Gertler and Gruber 1997, Hayashi, Altonji, and Kotlikoff 1996, Mace 1991, Nelson 1994, and Townsend 1994) can stabilize consumption. Recent research on implicit consumption insurance shares a common theoretical framework in which a hypothetical central planner allocates resources across households to equate the growth rates of the marginal utilities of consumption. The strong testable implication of complete consumption insurance is that after accounting for change in aggregate resources the growth of an individual household's consumption should not depend on changes in the household's own economic resources. With few exceptions (Altug and Miller 1990, Mace 1991), empirical research rejects complete implicit consumption insurance.

A progressive income tax produces partial implicit consumption insurance for households when income changes unexpectedly. There is little research on partial implicit consumption insurance; most of it focuses on developing countries (Deaton 1997, Gertler

and Gruber 1997), and little of it considers recent U.S. tax reforms (Auerbach and Feenberg 1999, Cohen and Follette 1999).

We specify a model of the evolution of consumption where the focus is on identifying the degree to which partial consumption insurance has changed because of ERTA and TRA86. To track time variation in partial risk sharing we use panel data and the Keane and Runkle (1992) forward-filter estimators of Euler equations with latent heterogeneity. Our data are from the Panel Study of Income Dynamics (PSID) for interview years 1980–1991, which encompasses the periods before ERTA and after TRA86. Food consumption is the measure examined most often by researchers using the PSID to test complete consumption insurance (Altug and Miller 1990, Cochrane 1991, and Hayashi, Altonji, and Kotlikoff 1996). Because the Food Stamp Program will stabilize food consumption it is plausible that the tax reforms of the 1980s did little to food consumption. We therefore study composite consumption constructed as a residual of income net of taxes and saving (Ziliak 1998).

We find that across the 1980s the progressive income tax stabilized household consumption by 15 percent in response to a given reduction in gross income. On balance, though, the tax reforms of the 1980s cut in half the stabilizing effect of the progressive income tax. Our results highlight an under-appreciated benefit of a progressive tax system, and how that benefit was reduced with the 1980s tax reforms. There are some exceptions. Due largely to changes in Social Security taxes and the Earned Income Tax Credit consumption was increasingly stabilized during the 1980s for low-income couples and single mothers in the upper half of the income distribution.

## 2. Conceptual Framework

The theory of complete consumption insurance begins with a social planner who, given household-specific social weights,  $\mathbf{m}^h$ , allocates resources under uncertainty across households and over time to equalize the growth rates of the marginal utilities of consumption. More formally, the planner's problem is to maximize the weighted sum of households' utilities, or

$$\text{Max} \sum_{h=1}^H \mathbf{m}^h \sum_{t=1}^T \sum_{s=1}^S (\mathbf{r}^h)^t \mathbf{p}_{st} U(c_{st}^h, \mathbf{d}_{st}^h), \quad (1)$$

where  $h$  indexes households,  $t$  indexes time,  $s$  indexes economic state,  $\mathbf{r}^h$  is the household's rate of time preference,  $\mathbf{p}_{st}$  is the probability of state  $s$  in time  $t$ ,  $c_{st}^h$  is the household's consumption in state  $s$  and time  $t$ , and  $\mathbf{d}_{st}^h$  indexes shocks to preferences across households and over time. The adding up constraint in the maximization problem posed is

$$\sum_{h=1}^H c_{st}^h = C_{st}, \quad (2)$$

or that the sum of households' consumption expenditures is aggregate consumption in state  $s$  at time  $t$ .

The choice variable is household consumption,  $c_{st}^h$ , and the first-order conditions for maximizing (1) subject to (2) are

$$(\mathbf{r}^h)^t \mathbf{m}^h \mathbf{p}_t U_c(c_t^h, \mathbf{d}_t^h) = \mathbf{l}_t, \quad (3)$$

where  $\mathbf{l}_t$  is the Lagrange multiplier associated with the resources constraint, and  $U_c$  is the marginal utility of consumption.<sup>1</sup>

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<sup>1</sup> We drop the subscript  $s$  because only one state is realized here at time  $t$ .

Taking the natural log of both sides of (3), first differencing to eliminate the fixed household social weight  $\mathbf{m}^h$ , and rearranging yields the Euler equation

$$\Delta \ln U_c(c_t^h, \mathbf{d}_t^h) = \Delta \ln I_t - \Delta \ln \mathbf{p}_t - \ln \mathbf{r}^h. \quad (4)$$

Equation (4) contains the key prediction of complete consumption insurance, which is that the discounted growth in the marginal utility of consumption is constant across households, so that given aggregate resources, changes in an individual household's resources do not affect how its marginal utility of consumption evolves.

To make equation (4) operational we need to specify a functional form for within period utility. We use the isoelastic utility function suggested by Deaton (1997)

$$U(c_t^h, \mathbf{d}_t^h) \equiv U(c_t^h, \mathbf{q}_t^h, \mathbf{s}) = (1 - \mathbf{s})^{-1} \mathbf{q}_t^h n_t^h (c_t^h / n_t^h)^{(1-\mathbf{s})}, \quad (5)$$

where  $\mathbf{q}_t^h$  is an unobservable taste shifter that captures time variation in the household's preferences,  $\mathbf{s}$  is the coefficient of relative risk aversion,  $n_t^h$  is the size of household  $h$  at time  $t$ , and  $c_t^h / n_t^h$  is per capita consumption. Given isoelastic preferences equation (4) becomes

$$\Delta \ln(c_t^h / n_t^h) = -\mathbf{s}^{-1} (\Delta \ln I_t^* - \Delta \ln \mathbf{q}_t^h - \ln \mathbf{r}^h) = -\mathbf{s}^{-1} (\Delta \ln I_t^* - \Delta \mathbf{e}_t^h). \quad (6)$$

With preference shocks that are mean zero stochastic disturbances, the growth of per capita consumption will be the same for all households.

Equation (6) is the mode specification used in the literature testing the complete consumption insurance hypothesis. The substantial literature emerging over the past decade tests the complete insurance hypothesis with data from developing countries (Deaton 1997, Gertler and Gruber 1997, Morduch 1995, Townsend 1994) as well as developed countries (Altug and Miller 1990, Attanasio and Davis 1996, Banks et al.

1997, Cochrane 1991, Hayashi et al. 1996, Mace 1991, Nelson 1994). The consensus finding is a resounding rejection of complete consumption insurance.

Rejection of complete insurance is probably not surprising given the attendant moral hazard problems inherent in devising comprehensive intra- and inter-household insurance schemes. At the same token, high-frequency co-movements in the relative wage and consumption distributions strongly reject the extreme alternative of no consumption smoothing (Attanasio and Davis 1996). Both public and private institutions clearly exist that offset consumption loss because of income loss. A more general approach to examining consumption insurance empirically admits partial consumption insurance, whose effectiveness may vary over time.

#### **A. The Income Tax as Partial Insurance**

Consider the U.S federal income tax system and the attendant reforms in the 1980s. If the only tradeoff facing policymakers is between the equity effects of changing the income distribution and the efficiency cost of reduced incentives, then the optimal income tax literature yields either a zero marginal income tax on the highest income earner (Stiglitz 1987) or a U-shaped marginal tax rate structure (Diamond 1998). However, if policymakers are also concerned about the variability of after-tax income and consumption, and some of the observed differences in income are due to exogenous differences in “luck,” then the marginal tax rate on the highest income earner might be quite large (Varian 1980; Strawczynski 1998). If redistribution and partial insurance are important policy objectives then a steeply progressive income tax system might provide beneficial collective insurance against unexpected changes in income and in turn smooth consumption.

[Table 1 here]

In Table 1 we present the U.S. federal tax rates for a married couple filing jointly for the year before and the year after ERTA (1980 and 1982), and the year before and the year after TRA86 (1985 and 1987). The pre-ERTA U.S. federal income tax system is targeted heavily towards redistribution and partial insurance. In 1980 there were 16 marginal tax rates, which increased by about 4 percentage points for each successive bracket above the zero bracket amount. At low levels of the taxable income distribution the tax brackets were quite narrow, implying a high probability of a tax-rate reduction in the event of an idiosyncratic income loss. ERTA did little with respect to the number and width of tax brackets, as evidenced by the rate schedules for 1982 and 1985. ERTA indexed the brackets for inflation by 1985 and reduced the marginal tax rates at all levels, especially for upper-income Americans. TRA86 slashed the number of statutory brackets to five in 1987 and to only two in 1988 (aside from the 33 percent “bubble” faced by some higher-income taxpayers). Under TRA86 the brackets were widened substantially, which reduces the probability of a tax-rate reduction in the presence of income loss. Changes to the U.S. federal income tax code in the 1980s suggest a reduced concern about the automatic stabilizing component of the system relative to the deadweight loss of reduced incentives. Indeed, the 1982 and 1987 issues of the *Economic Report of the President* contain extensive discussion of the efficiency costs of high income tax rates but no mention of the possible efficiency benefits via consumption smoothing.

An intuitive way to think about the partial-insurance capability of the federal income tax is through the curvature of the tax function. To facilitate intuition we graph the statutory rates for 1980 and 1987 in Figure 1. It appears that the pre-ERTA system is

more globally concave than the post-TRA86 rate structure; that is, the rate of change in marginal tax rates is greater overall before ERTA than after TRA86. However, the 1987 structure appears more locally concave in certain regions, particularly in the 15 to 28 percent marginal tax brackets. If the bulk of taxpayers are located just above the 28 percent tax kink, then it is possible that automatic stabilization actually increased with TRA86. In 1995 about 60 percent of taxpayers were in the 15 percent bracket, and about 17 percent were in the 28 percent bracket (Burman et al. 1998). Provided that the incomes of upper-income Americans are relatively rigid downward, the likely outcome was a decrease in automatic stabilization with TRA86.

[Figure 1 here]

Concurrent with the reforms to the federal income tax were reforms to the Social Security payroll tax (FICA) in the early 1980s and to the Earned Income Tax Credit (EITC) with TRA86. Because of concerns over the solvency of the Social Security program, Congress legislated an aggressive program to increase both the FICA tax base and tax rates. During 1980–1987 the FICA tax base increased by 70 percent from \$25,900 to \$43,800, and the payroll tax rate increased by 17 percent from 6.13 to 7.15 percent. Simultaneously, to counter the regressivity of the payroll tax and to stimulate work among low-income households, Congress expanded the EITC in 1986 by increasing the phase-in subsidy rate from 10 percent in 1980 to 14 percent in 1987 and by decreasing the phase-out rate from 12.5 percent to 10 percent. The declining phase-out tax rate resulted in a 54 percent increase in the cut-off income level for credit eligibility from \$10,000 to \$15,432. Collectively, reforms to Social Security and the EITC likely offset to some extent the declines in federal marginal tax rates for low and moderate-

income earners and may have restored the implicit automatic stabilization in the tax system.

To estimate how the partial consumption insurance implicit in the U.S. income tax system evolved during the 1980s we amend the Euler equation for household consumption so that the proportionate change in per capita consumption in equation (6) becomes

$$\Delta \ln(c_t^h / n_t^h) = \mathbf{a} \Delta \ln(C_t) + \mathbf{b} \Delta \ln(y_{dt}^h) + \Delta \mathbf{e}_t^h, \quad (7)$$

where aggregate consumption,  $C_t$ , represents aggregate resource constraints at time  $t$ , and

$$y_{dt}^h \text{ is the household's time } t \text{ disposable income, } y_{dt}^h \equiv y_t^h - T(y_t^h - E_t^h - D_t^h) + \underline{C}_t^h(y_t^h).$$

Total tax payments,  $T(\cdot)$ , are a function of taxable income defined as gross income less exemptions and deductions, and tax credits,  $\underline{C}(\cdot)$ , are a function of gross income. The complete consumption insurance hypothesis is that  $\mathbf{b} = 0$ . Under partial insurance changes in consumption will be a function of both aggregate and idiosyncratic resources ( $\mathbf{b} \neq 0$ ). With an effective partial insurance mechanism the impact of a gross-income

change on a per capita consumption change is  $\mathbf{b}(1 - \mathbf{t}_t^h) \frac{y_t^h}{y_{dt}^h}$ , where  $\mathbf{t}_t^h$  is the household's

marginal tax rate.

### 3. Data

Our data come from the Panel Study of Income Dynamics (PSID) for interview years 1980–1991. Because the survey has followed the same core households since 1968, plus newly formed households as members of the original core have split off into new families, the PSID contains detailed information on income and household composition. Our data span the two major recent income tax reforms in the United States, which

occurred in 1981 (ERTA) and 1986 (TRA86), and are the best available to study how a less graduated income tax affected the automatic stabilization that is a byproduct of a progressive income tax.

Our sample is an unbalanced panel that treats missing observations as exogenous (ignorable) events and eliminates only a missing person year of data so that the time series for each household can be of different length within 1980–1991. To be included in the sample the household head (1) must be at least 25 in 1980 and no more than 64 in 1991, (2) must be finished with schooling by 1980, (3) cannot be permanently disabled or institutionalized, and (4) must have the same marital status for 1980–1991 so as to keep the same tax table, which facilitates understanding how taxpayers who income split with a spouse for tax purposes may be differentially affected by the tax reforms of the 1980s. To reduce further the influence of household composition changes and possible outliers we follow the previous consumption literature and delete person-years with more than a 300 percent increase or more than a 75 percent decrease in consumption. We also require per capita consumption and disposable income to be no less than \$1000 in any year. Our selection criteria produce a sample of 1298 households with 12,341 person years of consumption.

The advantage of the PSID relative to repeated cross-section surveys such as the Consumer Expenditure Survey (CEX) is that the PSID follows the same households longitudinally, which makes it unnecessary to construct a time series on artificial households based on membership in demographic cohorts (Attanasio and Davis 1996). The disadvantage of the PSID is that it presents less ideal measures of consumption than the CEX. Previous studies using the PSID to test for complete consumption insurance

examine Euler equations for food consumption expenditures (Altug and Miller 1990, Cochrane 1991, Hayashi, Altonji, and Kotlikoff 1996). For comparability we too estimate Euler equations for food expenditures. Because tests of the permanent income hypothesis are known to be sensitive to the consumption measure, our focus is on a broader measure of consumption defined as the residual of income net of the change in wealth and taxes paid (Ziliak 1998).

To elaborate on the more comprehensive consumption measure we use, the PSID allows one to estimate household wealth ( $A_t^h$ ) alternatively as liquid assets (the capitalized value of rent, interest, and dividend income) or the sum of liquid assets and home equity (the difference between house value and mortgage principal). Given a measure of wealth, personal saving is the year-to-year change in wealth,  $S_t^h = A_{t+1}^h - A_t^h$ . Composite consumption then follows by subtracting saving from disposable personal income,  $C_t = y_{dt}^h - S_t$ . Although Ziliak (1998) focuses on the broader wealth measure, most of the flow in saving emanates from liquid sources. Moreover, it may be tenuous to define consumption as involving unrealized capital gains in the housing stock.<sup>2</sup> Most of our tests rely on the narrower definition of consumption based on liquid wealth.<sup>3</sup>

Our composite consumption measure is advantageous compared to food expenditures because food is likely to be stabilized by the Food Stamp Program. An unfortunate data problem also limits the usefulness of food consumption; the PSID did not collect food consumption for the 1988 and 1989 interview years, which are two

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<sup>2</sup> For an econometric examination of changes in home equity and saving see Engelhardt (1996).

<sup>3</sup> Our measure of net wealth might be understated because of omitted pensions. The lack of pension wealth data in the PSID should not be problematic for our purposes. During the 1980s over 60 percent of workers are not covered by private pensions (*Statistical Abstract of the United States 1998*). Moreover, the majority of pension plan participants (in 1980, for example, over 60 percent) are in defined benefit plans, which are

critical years after TRA86 needed to identify automatic stabilization effects. Our composite measure also improves on a predicted consumption measure for the PSID proposed by Skinner (1987) because Skinner's measure may be inaccurate if the relative prices of goods change (Attanasio and Weber 1995).<sup>4</sup>

A potential disadvantage of our consumption measure is that it implicitly includes durable goods, which introduces the difficulty of distinguishing between expenditures and service flows of consumption (Hayashi 1985). Hayashi includes durable consumption by modeling total consumption as a distributed lag of current and previous expenditures. Although we do not take the distributed lag approach for the evolution of consumption, we attempt to control for implied autocorrelation in our composite consumption measure via our econometric estimator as described below. We believe that the advantages of our residual based consumption measure over food consumption and Skinner's consumption measure are sufficient despite the amalgamation of durable and non-durable expenditures.

The final data issue we need note concerns key independent variables in our estimating equation (7); namely, gross family income and tax payments. Information is available to construct family income from labor and interest earnings and transfers received. Because transfer income such as unemployment insurance, food stamps, and AFDC is an important source of consumption insurance (Hamermesh 1982, Dynarski and

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highly illiquid because defined benefit pensions rarely offer the opportunity to borrow against them for current consumption purposes.

<sup>4</sup> Skinner (1987) used data from the Consumer Expenditure Survey in 1972–1973 to estimate expenditures on various components of consumption and their relation to total consumption. He then used his parameter estimates along with data for the independent variables from the PSID to produce a value of consumption that is  $C_t = 110.1 + 1.418*food (home) + 2.604*food (away) + 0.0988*house\ value + 1.538*rent + 2.257*utilities + 624.6*vehicles$ .

Gruber 1997, Gruber 1996, 1997) we include government transfers as part of income when identifying the automatic stabilization properties of income taxes.

With each wave until 1992 the PSID has used household income and estimates of deductions and exemptions to construct a household's marginal tax rate and tax payments. For exemptions the PSID has recorded the number of dependents used for tax purposes, and for deductions they have used the Internal Revenue Service's *Statistics of Income* to generate a typical value of itemized deductions for the household's adjusted gross income. Taxable income is then computed by subtracting positive values of excess itemized deductions (itemized deductions less the standard deduction) from gross income for tax years prior to 1987, or by subtracting the larger of itemized deductions and the standard deduction from gross income for tax years 1987 and beyond. Given taxable income, they then compute tax payments based on the statutory rates for each year. The PSID also computes an estimated value of the EITC for qualifying families so that tax payments can be negative. However, they omit both Social Security tax payments as well as state income tax payments. As in Ziliak and Kniesner (1999) we obtain an estimate of total taxes by adding to federal income taxes the estimated payroll tax payment and the state income tax payment using the average income tax rate for the household's state.<sup>5</sup>

A possible concern is the quality of the tax data available in the PSID relative to the population tax-return information collected by the Internal Revenue Service (IRS).

Although a comprehensive comparison of the PSID tax data with the IRS tax data is beyond our scope, we can compare the IRS' published 1980 average tax rates (*Statistical*

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<sup>5</sup> Nearly 75 percent of states use either federal AGI or taxable income in determining their tax base. Including the average state tax rate in the marginal tax rate is best viewed as a proportional tax over and above the federal marginal tax rate and is an additional source of consumption stabilization.

*Abstract of the United States, 1983*) to average tax rates for 1980 from the PSID. Because the IRS data are from households of all types, we select a fresh cross-section sample of heads of households in the 1980 PSID to make the PSID data maximally comparable to the IRS data. We report the average tax rates for adjusted gross income classes in Figure 2. With the exception of the very rich the PSID tax data compare favorably to the IRS data at all income levels.<sup>6</sup>

[Figure 2 here]

Before turning to estimation issues we present some summary information on our variables of interest. Figure 3 depicts average annual levels of real food consumption, real composite consumption, and real gross family income.<sup>7</sup> Aside from the two missing years the divergence between average food and average composite consumption is striking. Food accounts for about 10 percent of the average household's gross income, and composite consumption accounts for about 80 percent of gross income. Its much larger budget share means that composite consumption will be more responsive to a given income change than food consumption.

[Figure 3 and Table 2 here]

#### **4. Estimation Issues**

The complete implicit consumption insurance model in (6) can be estimated consistently using OLS (Cochrane 1991, Deaton 1997, Gertler and Gruber 1997, Mace 1991, Nelson 1994). Introducing household-specific disposable income to capture partial insurance makes estimating the Euler equation in (7) more complicated econometrically.

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<sup>6</sup> The shortfall in the high-income class is not surprising because it is difficult for a random sample to capture persons in the far right tail of the income distribution.

<sup>7</sup> We deflate food consumption by the food component of the CPI, and deflate composite consumption and income by the personal consumption expenditure deflator (base 1987).

It is unreasonable to assume that  $E(\Delta y_{dt}^h \Delta \mathbf{e}_t^h) = 0$  because the composite error term contains the household-specific discount factor,  $\ln \mathbf{r}^h$ , which is likely to covary with income over the life cycle. Another complexity we must confront in the econometric setup is that if disposable income is measured with error then it will covary contemporaneously with the error term in consumption.

### **A. Latent Heterogeneity**

Consider first the case where the evolution of gross income is not independent of the discount factor. Because the model in (7) is in first differences unobserved person-specific time-invariant heterogeneity in consumption levels is swept away. However, growth-rate heterogeneity may manifest itself in the household's discount factor. One econometric approach that immediately comes to mind is to treat the discount factor as fixed and sweep it out with either the within or the first-difference transformation. Eliminating discount rate heterogeneity with the first-difference transformation exacerbates measurement errors-in-variables problems relative to the within transformation and results in the loss of another year of data (Griliches and Hausman 1986). Here the within transformation makes predetermined variables invalid as instruments (Keane and Runkle 1992). Neither the simple first difference or within estimators are suitable for our purposes.

An alternative econometric approach is the correlated random-effects estimators of Mundlak (1978), who proposed using the individual's means of the time-varying regressors as proxies for the fixed effect, and Chamberlain (1984), who proposed using the linear projection of the time-varying regressors as proxies for the fixed effect. We use a correlated random-effects approach similar to Mundlak (1978), but instead of using the

individual's means of the time-varying regressors we follow more closely the method of Lawrance (1991), who estimates discount rates as a function of pre-sample information.

The equation for the discount factor we use is

$$\ln r^h = x^h \mathbf{j} + \mathbf{w}^h, \quad (8)$$

where  $x^h$  is a vector of pre-sample variables and  $\mathbf{w}^h$  is a random error. The variables we use as pre-sample information include the household head's education level, race, and five-year birth cohort, the latter of which are intended to capture cohort-specific differences in discount rates. Amended in light of (8) our estimating equation becomes

$$\Delta \ln(c_t^h / n_t^h) = \mathbf{a} \Delta \ln(C_t) + \mathbf{b} \Delta \ln(y_{dt}^h) + x^h \mathbf{j} + \Delta \mathbf{z}_t^h, \quad (9)$$

where  $\Delta \mathbf{z}_t^h = \mathbf{w}^h + \Delta \mathbf{q}_t^h$ .

## B. Measurement Error

Estimation of equation (9) is further complicated by possible measurement error in changes in disposable income. In the case of income changes there are two, possibly offsetting, sources of measurement error. First, there is classical attenuation bias in the coefficient toward zero due to incorrect measurement of the various income components and tax payments. Second, there may be a positive bias arising because the household's income is used to construct the dependent variable, composite consumption. It is impossible to determine a priori whether stochastic components of income make the regression coefficient of disposable income likely to be biased upward or downward, if at all.<sup>8</sup>

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<sup>8</sup> Deaton (1997, p. 381) confronts a similar measurement error problem in his complete consumption insurance tests applied to data from the Cote d'Ivoire.

To estimate the parameters of equation (9) consistently we specify a vector of moment conditions,  $E(z_t^h \Delta \mathbf{z}_s^h) = 0 \forall s \geq t$ , which use an available set of predetermined instruments,  $z_t^h$ , that are maintained to be orthogonal to the contemporaneous error term.<sup>9</sup> One possible approach to estimating the moment conditions is two stage least squares (2SLS). Because the error term  $\Delta \mathbf{z}_t^h$  contains both random time-invariant heterogeneity,  $\mathbf{w}^h$ , and an MA(1) component,  $\Delta \mathbf{q}_t^h$ , serial correlation is likely problematic. As discussed previously, composite consumption implicitly contains durable goods, which may also generate autocorrelation. Consequently, 2SLS will not be efficient. A tractable approach admitting general forms of serial correlation, due both to unobserved heterogeneity and to the moving average process in  $\Delta \mathbf{z}_t^h$ , is Keane and Runkle's (1992) forward-filter estimator.

The forward filter estimator, which still maintains orthogonality with the original set of predetermined instruments, has several steps. First, we estimate equation (9) by 2SLS and save the  $(T-2)$  vector of estimated residuals for each household,  $\Delta \hat{\mathbf{z}}^h$ . We then compute a  $(T-2) \times (T-2)$  matrix,  $\hat{C} = (\frac{1}{H} \sum \Delta \hat{\mathbf{z}}^h \Delta \hat{\mathbf{z}}^{h'})^{-1}$ , and filter it with an upper-triangular Cholesky decomposition. Last, we premultiply (9) by  $\hat{Q} = (I_H \otimes \hat{C})$  and estimate the transformed, forward-filtered equation using the original set of instruments. Although Hansen's (1982) Generalized Method-of-Moments (GMM) estimator is efficient for this class of problems, recent bootstrap Monte Carlo evidence is that the

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<sup>9</sup> Following Hayashi et al. (1996), we balance the unbalanced data by setting to zero incalculable changes in consumption across years resulting from missing person years. The procedure guarantees positive semi-definiteness of the fourth moments and ensures that the expectation of the moment condition is zero.

estimator we use has good finite-sample properties relative to 2SLS and GMM (Ziliak 1997).

## 5. Empirical Results

We begin estimating (9) by specifying a base-case model where total household consumption is disposable income net of the change in liquid wealth. In addition to a constant the instrument set has values at time  $(t-1)$  of the head's annual hours of work, age, number of children, real hourly wage, the state unemployment rate, and dummies for marital status, health status, spouse's education, geographic region, industry, occupation, union status, home ownership, and female headship and values at time  $(t-2)$  of real disposable income. As specification checks on instrument sets we test the validity of the overidentifying restrictions with the Sargan test, and test the exogeneity of selected instruments with a pseudo likelihood-ratio test (Eichenbaum et al. 1988).

Column (1) of Table 3 reports base-case estimates. The estimated coefficient on the change in log disposable income is highly statistically significant, which is consistent with the existing consumption-smoothing literature's rejection of the complete consumption insurance hypothesis. The base case estimate of  $\hat{b}$  indicates that absent an offset from income taxation a 10 percent decrease in gross family income makes composite consumption fall by 9 percent. When evaluated at the overall sample means, the post-tax effect of a 10 percent reduction in gross income is a 7.7 percent reduction in consumption  $(0.9067 \times (1 - 0.316) \times (42240/34040))$ . On average, the progressive federal income tax in the 1980s stabilized consumption losses by about 15 percent, which is an under-appreciated benefit to households who experience idiosyncratic income losses.

[ Table 3 here ]

The Sargan test reported in the last row of Table 3 indicates that the overidentifying restrictions are satisfied collectively at the 4 percent significance level.<sup>10</sup> As an additional specification check on the results in column (1) we test the exogeneity of some of the instruments: the household head's hours of work at time  $t-1$  and the household's disposable income at time  $t-2$ . Disposable income at  $t-2$  may fail exogeneity if there is sluggish adjustment of consumption changes to past income. Hours of work may fail exogeneity if consumption and leisure are not separable in utility, although by including gross income we are implicitly allowing nonseparability between consumption and leisure. Testing for instrument exogeneity involves taking the difference between the restricted and unrestricted Sargan tests, which is distributed as  $\chi^2(m)$  with degrees of freedom equal to the number of restrictions. Comparing the specification in column (1) with the specifications in columns (2) and (3) indicates that the null hypotheses of exogeneity of hours of work at  $(t-1)$  and exogeneity of disposable income at  $(t-2)$  of cannot be rejected. Because the Sargan tests indicate that the instrument exclusions we examine do not improve the model, the specification in column (1) is the preferred model in Table 3.<sup>11</sup>

#### **A. Automatic Stabilization After ERTA and TRA86**

To gauge how the automatic stabilizing component of the income tax has changed because of ERTA and TRA86 we offer some illustrative calculations of the percentage

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<sup>10</sup> Perhaps more important is the overidentifying restrictions test from the first-stage 2SLS regression because it provides the basis for the filtered residuals. The corresponding  $p$ -value of the first-stage Sargan test is 0.67, indicating that the overidentifying restrictions are not invalid.

<sup>11</sup> As a final check of our preferred specification's instrument quality we estimated the model with OLS. The estimated net income parameter is 0.804 with a standard error of 0.015. If our instruments were weak then our forward-filter estimates will be close to the OLS estimates, which is not the case. The comparison of OLS and forward-filter estimates coupled with the first-stage F-test of instrument relevance of 6.91 indicates that our instruments are of good quality.

reduction in the effect of gross-income changes on consumption changes that can be attributed to income tax offsets. In particular, we examine the consumption impact of gross-income cuts of 10 and 30 percent under each of the tax regimes in effect during the 1980s compared to the impact of the income cuts on consumption that would occur in the absence of income taxes. We also evaluate the additional contribution to the automatic stabilization of consumption due to FICA and the EITC.

Our reference cases are a married couple filing jointly with two children and a female head of household with two children.<sup>12</sup> To compare households situated similarly in the income distribution we consider married and female-headed households with the median, 50 percent of the median, and 150 percent of the median U.S. gross incomes from selected years of the Current Population Survey. We also examine a typical married couple located in the top 5 percent of the income distribution to gauge how the tax system has stabilized the consumption of the wealthy.

*Income Taxes in Isolation.* Table 4 presents our calculations applicable to a 10 or 30 percent cut in gross income evaluated at current dollars. The general pattern is a substantial decline in automatic stabilization of consumption associated with the 1980s tax reforms. For a married couple with the median U.S. income for married couples the 1980 tax system reduced the impact on consumption of a 10 percent cut in gross income by 13 percent. In 1980, if a median-income married couple suffered a 10 percent income cut the household fell from the 28 to the 24 percent marginal tax bracket. As of 1987 the household remains in the 15 percent bracket and receives only a 6 percent offset from the income tax system, which is a reduction in stabilization of 55 percent. Married couples

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<sup>12</sup> For each representative filing unit we apply the standard deduction (which is built into the pre-TRA86 tax tables) and personal exemptions specific to each tax year in calculating taxable income.

with median, 50 percent of median, and 150 percent of median incomes suffering 30 percent income reductions have comparable (50 percent) declines in tax-reform induced consumption stabilization during the 1980s.<sup>13</sup>

[ Table 4 here]

For female-headed households at half the median U.S. income for their group, the tax system provides no consumption-smoothing benefits for income losses, whereas median income female-headed households experiencing 30 percent declines in income faced a 100 percent decline in consumption stabilization from 1980 to 1987. Single mothers at one-half the median income are outside the federal income tax system altogether, while single mothers at the median income experience declines in their marginal tax rate from 14 percent to zero. Although low-income single mothers have access to the transfer system for consumption stabilization, reductions in both the generosity of real transfer payments and in access to programs after passage of the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 makes consumption stabilization less in evidence.

*FICA and the EITC.* Perhaps surprisingly, our general conclusions do not change much with the inclusion of FICA and the EITC. Although the level of stabilization increases with additional taxes related to income, in most circumstances the downward trend in stabilization brought about by the federal income-tax reforms dominates. Exceptions to the trend toward less stabilization of consumption following the tax reforms of the 1980s are female heads at 150 percent of the median income facing 10

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<sup>13</sup> We also did the exercise of Table 4 with in-sample data, which produces comparable results. For the median taxpayer the stabilization effect of the tax system was about 17 percent in both the 1980 and 1982 tax years, but by tax year 1987 the stabilizing effect had fallen to about nine percent, which is about a 47 percent reduction after TRA86.

percent income cuts and female heads at the median income facing 30 percent cuts. By 1987 single mothers at 150 percent of the median income qualified for the EITC after a 10 percent income decline and in turn experienced a 95 percent increase in post-tax stabilization. In the case of single mothers at the median income, rather than a 100 percent decline in stabilization there is only a 9 percent decline because of the payroll tax and the EITC.

In the 1980s the EITC only affected very low-income households. Married couples with 50 percent of the median income only qualify for the EITC after large income losses, and so that the EITC offered a consumption buffer for a limited subset of households during the 1980s. As discussed more below, the program's expansions in the 1990s now make the EITC reach deeper into the income distribution and play a more important role in stabilizing consumption.

*Constant Dollars.* A possible limitation with using current income in the calculations of Table 4 is that the income distribution should be an endogenous function of the tax system. A more informative exercise may be to calculate consumption stabilization based on constant dollars (Kasten et al. 1994). Table 5 repeats the calculations of Table 4 with income in constant (1985) dollars. A few noticeable differences appear. Low-income married households experienced a doubling of collective insurance once the payroll tax and EITC are included, and female-headed households at 150 percent of the median experienced a more than doubling of stabilization after 30 percent income cuts. The overall pattern still emerging when we account for an effect of the progressive income tax system on the gross income distribution in the United States is that the tax reforms of the 1980s reduced collective insurance for households.

[Table 5 here]

## B. Sensitivity Checks

Our final econometric activity is to examine whether our central conclusion that the progressive federal income tax system provides collective insurance benefits to households depends on any obvious econometric detail. Table 6 presents the results of six sensitivity checks, where for ease of comparison we repeat the base-case estimates from specification (1) of Table 3.

[Table 6 here]

*Smooth Tax Function.* Our first robustness check is to replace the tax payments constructed by the PSID staff that we use in calculating disposable income with tax payments estimated from a tax function that is approximated by a smooth cubic polynomial in taxable income. A smooth tax function is an econometrically attractive alternative to the piece-wise linear approach to estimating tax effects of labor supply (MaCurdy et al. 1990, Ziliak and Kniesner 1999). In the smooth income tax approach the payroll and average state income tax rates still apply, but the federal rate is a continuously differentiable function. When we use the smooth tax rate function in estimating the Euler equation for consumption the estimated amount of automatic stabilization is virtually unchanged. That the estimates based on a smooth tax function are in accord with estimates based on the PSID's tax rates lends further support that the taxes computed by the PSID are comparatively well measured.

*Aggregate Resources.* Equation (9), which we use to examine the impacts of income tax reforms on consumption stabilization, is similar econometrically to what researchers use to test the permanent income hypothesis (Hall and Mishkin 1982, Lusardi

1996, Runkle 1991, Zeldes 1989, Ziliak 1998).<sup>14</sup> If we replace aggregate consumption by the after-tax interest rate, and if the after-tax interest rate captures aggregate business cycle conditions, then a non-zero coefficient on income changes indicates excess sensitivity.

Chamberlain (1984) notes that tests of the permanent-income hypothesis are valid to the extent that the after-tax interest rate captures aggregate resources. Likewise, tests of partial insurance using (9) are valid to the extent that  $C_t$  adequately tracks aggregate resources. As a check on the assumption that aggregate consumption tracks aggregate resources well we replace average consumption with time dummies in the third column of Table 6. The estimated effect of disposable income changes on consumption changes is little affected by the use of time dummies, lending support to our base-case specification.

*Additional Latent Heterogeneity.* If our correlated random-effects specification for the discount rate does not adequately capture unobserved growth-rate heterogeneity then there may be additional latent heterogeneity in the Euler equation for consumption growth (9). For completeness we have estimated the baseline specification in first-difference form (difference in consumption differences), and the result appears in column (4) of Table 6. Allowing for additional person-specific heterogeneity not captured in the consumption Euler equation covariates lowers the estimated marginal effect of disposable income on consumption by about seven percent, or  $\hat{b}$  falls from about 0.91 to about 0.85. When evaluated at the overall sample means the estimated effect of a 10 percent cut in gross income is to reduce consumption by 7.3 percent, which is about 14.7 percent less

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<sup>14</sup> It is possible to have complete consumption insurance and yet violate the permanent income hypothesis, or vice versa (Cochrane 1991).

than a comparable cut without a stabilizing tax offset. The estimated partial insurance effect of income-based taxation is nearly identical to the base case estimate of 15 percent, which suggests that our correlated random effects specification captures time-invariant heterogeneity in the evolution of consumption reasonably well.

*Income.* We have implicitly been aggregating labor, capital, and transfer incomes as though they receive the same tax treatment, which was generally not the case in the pre-TRA86 system. In another sensitivity check we replace total real family income with income that is only subject to taxation and reconstruct disposable income.

When the change in taxable income is the focal regressor, a 10 percent cut in disposable income results in only a 6 percent reduction in consumption. Greater variability in capital and transfer income apparently makes consumption changes less responsive to taxable-income changes than to total-income changes. Evaluated at the sample mean values of the marginal tax rate and gross and net incomes, our results using taxable income are that the income tax system reduces by 14 percent the impact of a taxable income change on consumption, which is comparable to our base-case estimate of 15 percent. Our main conclusion is preserved that the tax system continues to provide a substantial tax offset to gross-income changes.

*Consumption Measure.* The last two econometric checks we consider involve changing our measure of consumption. First, we re-define saving to include changes in home equity when constructing composite consumption. Applying our sample-selection filters results in a loss of 1540 person-years because changes in home valuation are likely subject to considerable measurement error. The impact of changes in gross income on consumption changes is dampened relative to the base case, but the estimated income-tax

offset remains strong. One possibility for the observed difference in the estimated  $\hat{b}_s$  is that when unrealized capital gains in the home are treated as another form of saving one produces a far less accurate characterization of the economic link between income and consumption.

For completeness we mimic the previous consumption-insurance literature using the PSID and measure consumption with real food expenditures. Although there is evidence of automatic stabilization the coefficient on disposable-income changes is considerably smaller, which is consistent with our prior that the Food Stamp program is the main avenue of insurance for food consumption. In the Euler equation for food consumption there is strong rejection of the overidentifying restrictions, which further implies a need for consumption measures broader than food expenditures when testing the implicit consumption insurance hypothesis.

### **C. Tax Reforms of the 1990s**

It will prove additionally instructive to infer whether and how much the automatic stabilization of consumption changed as a result of the Omnibus Budget Reconciliation Acts of 1990 and 1993 and the Taxpayer Relief Act of 1997. The tax reforms of the 1990s partially reversed the move toward fewer brackets begun with TRA86 in favor of a rate structure more like the 1987 situation. Instead of the two tax brackets present in 1988 by 1998 there were five marginal tax rates: 15, 28, 31, 36, and 39.6 percent. Significant expansions of the payroll tax base and rates continued; by 1998 the applicable base was \$68,400 with a rate of 7.65 percent. More significant for low-income households was the substantial increase in the generosity of the EITC. From 1987 to 1998 the phase-in rate increased from 14 to 40 percent, the maximum tax credit increased from \$851 to \$3756,

and the phase-out rate increased from 10 to 21 percent. The greater number of tax rates, the broader payroll tax base, and the higher EITC subsidy and phase-out rates should make automatic stabilization greater at the end of the 1990s than at the end of the 1980s.

To examine the possibility of increased stabilization of consumption by changes in income-related taxes during the 1990s we conduct an exercise analogous to the calculations in Table 5 by using our estimated consumption Euler equation with tax system data for 1998. When taken in isolation, changes to the federal personal income tax during the 1990s created a slight increase in the income-tax offset for taxpayers facing a large (30 percent) negative income shock. Exceptions to the increased stabilization of consumption by the personal income tax during the 1990s are low-income couples and single mothers who have less consumption stabilization because they were eliminated from the tax rolls by the more generous standard deduction and personal exemption in 1998.

When factoring in the impact of FICA and the EITC there are several instances of greatly increased automatic-consumption stabilization. A married couple with the median income suffering a 30 percent gross income reduction had the shock to consumption reduced by 40 percent in 1998 versus reduced by nine percent in 1987. The reason for the substantial increase in consumption insurance is that the median income married couple now falls into the phase-out range of the EITC and faces a substantially higher marginal tax rate than 10 years ago. Similarly enlarged consumption stabilization during the 1990s appears for married couples at 50 percent of the median income and single mothers at 150 percent of the median income. Relatively high-income married couples (the upper 20 percent of the income distribution) also experienced increased consumption insurance

against large income losses during the 1990s because of the expanded FICA base. Overall there has been a restoration or expansion of collective consumption insurance in the federal income-related tax system during the 1990s driven largely by the increased generosity of the EITC.

## 6. Conclusion

We specify a model of partial implicit consumption insurance with disposable income as the focal regressor. Our data are from the Panel Study of Income Dynamics for interview years 1980–1991, and our measure of consumption is income net of taxes and liquid saving. The econometric model treats person-specific discount rates as a correlated random effect. To control for possible endogenous explanatory variables and serial correlation we use a forward-filter estimator. The goal of our research is to identify the degree to which the automatic stabilization of consumption has changed because of ERTA and TRA86.

On average, the progressive income tax system stabilizes consumption by about 15 percent in the face of idiosyncratic shocks to income. In some cases tax reforms of the 1980s actually increased the automatic stabilization inherent in a progressive income tax, but the typical outcome is that ERTA and TRA86 reduced composite consumption stability by about 50 percent, even after controlling for changes in FICA and the EITC during the 1990s. More recent tax reforms, most notably increased EITC generosity, have restored or enhanced consumption insurance for certain economic groups, single mothers and low income married couples.

Our results highlight an under-appreciated benefit to households implicit in a progressive income tax. Undoubtedly the deadweight loss from reduced incentives

declined for many taxpayers with the 1980s tax reforms. However, there was also a welfare loss from the reduction in collective insurance. An important topic for future research is to evaluate the offsetting welfare gains and losses from static versus dynamic efficiency effects of changes in the structure of personal income-based taxes.

**Table 1: Tax Rate Schedules for Married Taxpayers in Selected Tax Years<sup>a</sup>**

1980		1982	
Taxable Income (\$1000s)	Marginal Tax Rate (%)	Taxable Income (\$1000s)	Marginal Tax Rate (%)
3.4 or less	0	3.4 or less	0
3.4–5.5	14	3.4–5.5	12
5.5–7.6	16	5.5–7.6	14
7.6–11.9	18	7.6–11.9	16
11.9–16.0	21	11.9–16.0	19
16.0–20.2	24	16.0–20.2	22
20.2–24.6	28	20.2–24.6	25
24.6–29.9	32	24.6–29.9	29
29.9–35.2	37	29.9–35.2	33
35.2–45.8	43	35.2–45.8	39
45.8–60.0	49	45.8–60.0	44
60.0–85.6	54	60.0–85.6	49
85.6–109.4	59	85.6–109.4	50
109.4–162.4	64	109.4–162.4	50
162.4–215.4	68	162.4–215.4	50
215.4+	70	215.4+	50

1985		1987	
Taxable Income (\$1000s)	Marginal Tax Rate (%)	Taxable Income (\$1000s)	Marginal Tax Rate (%)
3.54 or less	0	3.0 or less	11
3.54–5.72	11	3.0–28.0	15
5.72–7.91	12	28.0–45.0	28
7.91–12.39	14	45.0–90.0	35
12.39–16.65	16	90.0+	38.5
16.65–21.02	18		
21.02–25.6	22		
25.6–31.12	25		
31.12–36.63	28		
36.63–47.67	33		
47.67–62.45	38		
62.45–89.09	42		
89.09–113.86	45		
113.86–169.02	49		
169.02+	50		

<sup>a</sup> Taxable income for tax years prior to 1987 is typically defined as adjusted gross income less exemptions and excess itemized deductions (the excess of itemized deductions over the zero bracket amount). For 1987 and beyond taxable income is defined as adjusted gross income less exemptions and the larger of itemized deductions or the standard deduction.

**Table 2:** Selected Summary Statistics

Variable	Sample Mean	Standard Deviation
$\Delta \ln(\text{Composite Consumption Per Capita})$	0.009	0.380
$\Delta \ln(\text{Disposable Income})$	0.012	0.246
Marginal Tax Rate	0.316	0.099
Gross Income (\$10000s)	4.224	3.293
Disposable Income (\$10000s)	3.404	2.459
White	0.677	0.468
Less than High School	0.224	0.417
High School	0.369	0.483
More than High School	0.406	0.491
Birth Cohort 1	0.282	0.450
Birth Cohort 2	0.273	0.446
Birth Cohort 3	0.163	0.370
Birth Cohort 4	0.133	0.339
Birth Cohort 5	0.149	0.356

**Table 3:** Forward-Filter Estimates of the Impact of Disposable Income on  $\Delta \ln(\text{Consumption Per Capita})^a$

	(1) <sup>b</sup>	(2) <sup>c</sup>	(3) <sup>d</sup>
$\Delta \ln(\text{Sample Consumption})$	0.3050 (0.0782)	0.2936 (0.0808)	0.3279 (0.0873)
$\Delta \ln(\text{Disposable Income})$	0.9067 (0.0910)	0.9409 (0.1069)	0.8361 (0.1476)
White	-0.0141 (0.0047)	-0.0143 (0.0047)	-0.0138 (0.0047)
High School	-0.0119 (0.0047)	-0.0125 (0.0049)	-0.0107 (0.0051)
More than High School	-0.0265 (0.0064)	-0.0274 (0.0065)	-0.0245 (0.0071)
Birth Cohort 2	0.0203 (0.0053)	0.0203 (0.0053)	0.0201 (0.0052)
Birth Cohort 3	0.0314 (0.0070)	0.0316 (0.0070)	0.0312 (0.0070)
Birth Cohort 4	0.0536 (0.0077)	0.0544 (0.0078)	0.0519 (0.0082)
Birth Cohort 5	0.0345 (0.0082)	0.0355 (0.0083)	0.0326 (0.0085)
Sargan Test <sup>e</sup>	50.9269 [35, 0.040]	50.5525 [34, 0.034]	49.2969 [33, 0.034]

<sup>a</sup> Heteroskedasticity and autocorrelation-consistent standard errors are in parentheses. NT=11043.

<sup>b</sup> The instrument set includes a constant,  $(t-1)$  values of head's annual hours of work, age of head, the number of children, the head's real hourly wage, state unemployment rate, dummies for marital status, health status, spouse's education, geographic region, industry, occupation, union status, female head, and home ownership, along with  $(t-2)$  values of real disposable income.

<sup>c</sup> Specification (1) instruments without  $(t-2)$  values of real disposable income.

<sup>d</sup> Specification (2) instruments without  $(t-1)$  head's annual hours of work.

<sup>e</sup> The Sargan Test is for the validity of the overidentifying restrictions, with degrees of freedom and  $p$ -values given in square brackets.

**Table 4:** Extent of Automatic Stabilization of Consumption  
For Alternative Tax Years and Tax Filing Status  
(Inclusive of FICA and the Earned Income Tax Credit)<sup>a</sup>

10 Percent Cut in Gross Income (Current \$'s)							
Tax Year	Married Couple with 2 Children				Female Head with 2 Children		
	50% of Median	Median	150% of Median	Top 5%	50% of Median	Median	150% of Median
1980	11.76 (12.57)	13.22 (14.21)	17.22 (12.05)	24.76 (21.20)	0.00 (0.00)	12.21 (30.05)	10.34 (11.08)
1982	11.15 (11.99)	14.31 (15.50)	18.35 (12.11)	25.34 (21.20)	0.00 (0.00)	8.08 (25.26)	8.63 (9.31)
1985	8.59 (9.25)	11.34 (12.32)	18.95 (12.26)	18.95 (14.20)	0.00 (0.00)	7.89 (24.54)	9.94 (10.76)
1987	11.31 (12.22)	5.99 (6.51)	16.14 (9.50)	18.60 (13.97)	0.00 (0.00)	9.06 (24.99)	9.29 (21.66)
30 Percent Cut in Gross Income (Current \$'s)							
Tax Year	Married Couple with 2 Children				Female Head with 2 Children		
	50% of Median	Median	150% of Median	Top 5%	50% of Median	Median	150% of Median
1980	12.39 (28.49)	12.57 (13.49)	15.99 (17.23)	21.83 (17.31)	0.00 (0.00)	12.71 (20.79)	10.65 (26.92)
1982	11.48 (26.96)	10.24 (11.06)	17.13 (18.59)	23.39 (18.17)	0.00 (0.00)	10.34 (30.44)	8.84 (24.47)
1985	8.57 (10.17)	9.32 (10.11)	12.93 (14.09)	16.79 (10.75)	0.00 (0.00)	8.81 (28.39)	8.83 (23.96)
1987	9.68 (23.87)	7.58 (8.22)	5.18 (5.63)	22.71 (17.27)	0.00 (0.00)	0.00 (18.97)	11.64 (26.23)

<sup>a</sup> The numbers in the table reflect the percentage reduction from the no-tax case in the effect of gross income changes on consumption changes due to marginal tax rates and tax payments. Each representative filing unit is assumed to take the standard deduction and personal exemptions in calculating taxable income.

**Table 5: Extent of Automatic Stabilization of Consumption**  
 For Alternative Tax Years and Tax Filing Status  
 (Inclusive of FICA and the Earned Income Tax Credit)<sup>a</sup>

10 Percent Cut in Gross Income (\$1985)							
Tax Year	Married Couple with 2 Children				Female Head with 2 Children		
	50% of Median	Median	150% of Median	Top 5%	50% of Median	Median	150% of Median
1980	11.08 (11.86)	14.56 (8.52)	26.26 (22.55)	27.49 (24.67)	0.00 (0.00)	11.71 (27.02)	14.01 (15.05)
1982	10.62 (11.44)	13.65 (14.80)	24.91 (19.44)	24.33 (20.30)	0.00 (0.00)	9.68 (26.36)	12.38 (13.36)
1985	8.56 (9.25)	11.34 (12.32)	18.95 (12.26)	18.95 (14.20)	0.00 (0.00)	7.89 (24.54)	9.94 (10.76)
1987	12.05 (24.29)	6.41 (6.96)	17.13 (10.13)	19.71 (14.85)	0.00 (0.00)	9.66 (26.36)	9.91 (22.90)
30 Percent Cut in Gross Income (\$1985)							
Tax Year	Married Couple with 2 Children				Female Head with 2 Children		
	50% of Median	Median	150% of Median	Top 5%	50% of Median	Median	150% of Median
1980	11.62 (12.42)	13.06 (14.04)	17.02 (19.84)	24.50 (20.96)	0.00 (0.00)	12.06 (29.77)	10.21 (10.94)
1982	10.94 (11.75)	13.04 (14.09)	21.09 (22.89)	22.43 (17.38)	0.00 (0.00)	9.85 (29.30)	10.46 (25.69)
1985	8.57 (9.24)	9.32 (10.11)	12.93 (14.09)	16.79 (10.75)	0.00 (0.00)	8.81 (28.40)	8.83 (23.96)
1987	10.32 (24.33)	8.09 (8.77)	5.54 (6.02)	15.35 (9.00)	0.00 (0.00)	0.00 (20.09)	12.39 (27.64)

<sup>a</sup> The numbers in the table reflect the percentage reduction from the no-tax case in the effect of gross income changes on consumption changes due to marginal tax rates and tax payments. Each representative filing unit is assumed to take the standard deduction and personal exemptions in calculating taxable income.

**Table 6:** Sensitivity of the Effect of Disposable Income Changes on Log Per Capita Consumption Changes to Alternative Specifications<sup>a</sup>

	Base Case <sup>b</sup>	Smooth MTR <sup>c</sup>	Time Dummies <sup>d</sup>	First Difference <sup>e</sup>	Taxable Income <sup>f</sup>	Home Equity <sup>g</sup>	Food <sup>h</sup>
$\Delta \ln(\text{Disposable Income})$	0.9067 (0.0910)	0.8844 (0.0898)	0.9193 (0.0923)	0.8537 (0.1456)	0.6074 (0.0797)	0.6308 (0.1305)	0.2722 (0.0826)
Sargan Test <sup>i</sup>	50.9269 [35, 0.040]	52.9925 [35, 0.026]	45.2889 [35, 0.114]	45.2889 [35, 0.114]	64.2018 [35, 0.002]	75.9747 [35,0.000]	117.7213 [35, 0.000]

<sup>a</sup> Heteroskedasticity and autocorrelation-consistent standard errors are given in parentheses.  $NT = 11,043$ .

<sup>b</sup> The base case refers to Specification (1) of Table 3.

<sup>c</sup> The marginal tax rate is approximated by smooth, cubic polynomial in taxable income.

<sup>d</sup> Time dummies are used as covariates in place of the sample average of consumption.

<sup>e</sup> Model in equation (7) is estimated in first differences.  $NT = 9315$ .

<sup>f</sup> Gross income only includes household income subject to taxation.  $NT = 10,610$ .

<sup>g</sup> Saving is defined broadly to include changes in home equity in constructing composite consumption.  $NT = 9,503$ .

<sup>h</sup> Composite consumption is replaced by food consumption.  $NT = 9,874$ .

<sup>i</sup> The Sargan Test is for the validity of the overidentifying restrictions with degrees of freedom and  $p$ -values given in square brackets. See notes to Table 3 for additional details.

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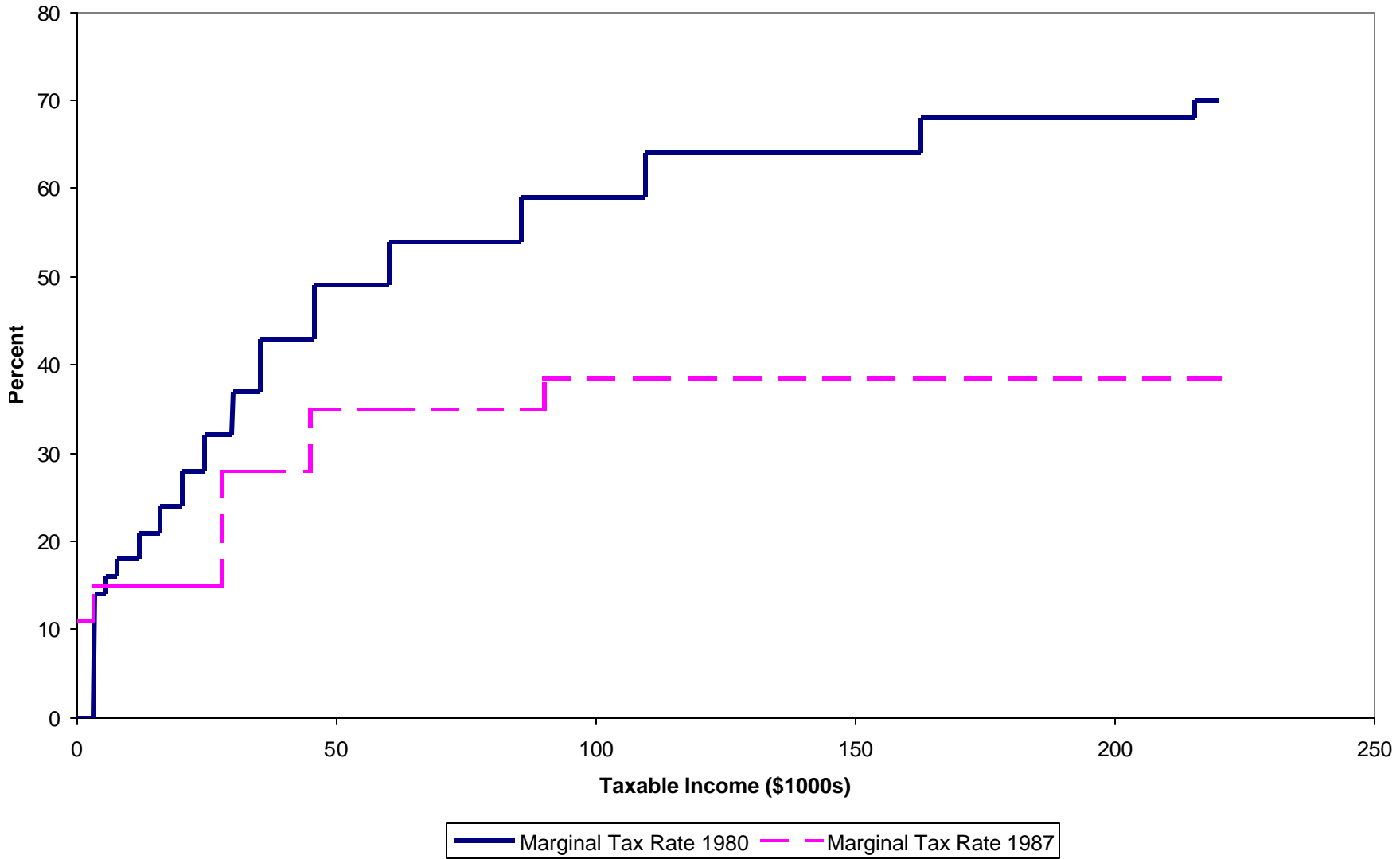
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Figure 1: Statutory Federal Marginal Tax Rates for Married Couples Filing Jointly



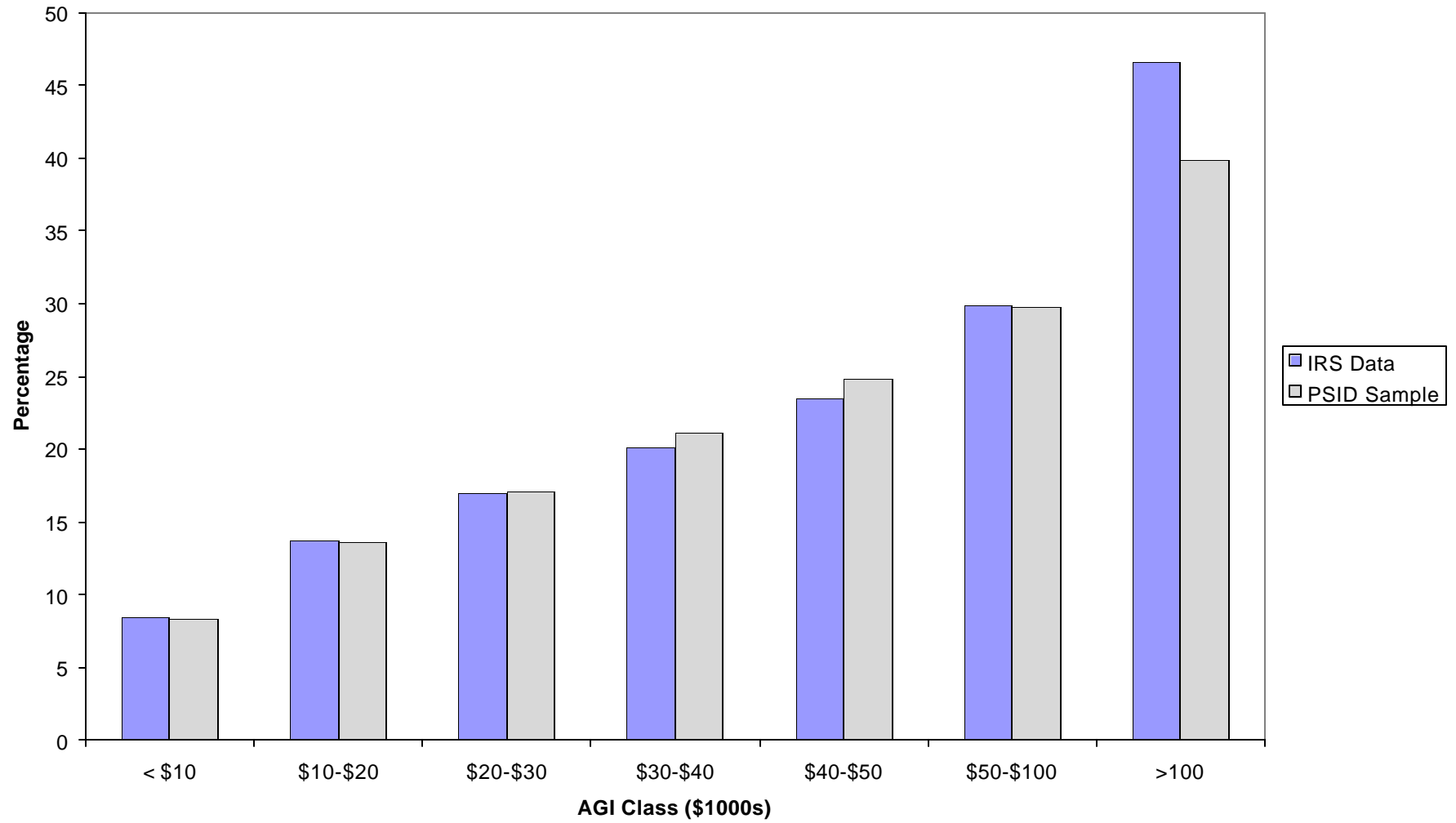
**Figure 2: Average Tax Rates for 1980 IRS and PSID Tax Returns by Adjusted Gross Income**

Figure 3: Levels of Consumption and Income, 1980-1990

