Inertia and Overwithholding: Explaining the Prevalence of Income Tax Refunds*

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Abstract

Over three-quarters of US taxpayers receive income tax refunds, indicating tax prepayments above the level of tax liability. This amounts to a zero interest loan to the government. Previous studies have suggested two main explanations for this behavior: precautionary behavior in light of tax uncertainty and/or a forced savings motive. I present evidence on a third explanation: inertia. I find that tax filers only partially adjust tax prepayments in response to changes in default withholdings or tax liability. I use three different settings for identification: (1) a 1992 change in default federal withholding, (2) a panel study of child dependents and tax liability, and (3) the expansion of the Earned Income Tax Credit (EITC) during the 1990s. In the first two cases, I find that individuals offset less than 43% of a change to their expected refund after one year, and about 58% of this shock after three years. Adjustments in tax prepayments by EITC recipients offset no more than 2% of a change in tax liability. Given the evidence on inertia, the design of default withholding rules is no longer a neutral decision made by the social planner, but rather, may affect consumption smoothing, particularly for low-income tax filers.

JEL Classification: D14, H24, K34

1 Introduction

A growing body of evidence suggests that the behavior of a substantial share of the population deviates from what is typically assumed in economic theory [see Rabin, 1998; DellaVigna, 2008, for overviews]. Recent studies have shown that departures from "standard" behavior may be particularly important in the field of public finance, especially when it comes to calculating the welfare effects of various policies [Bernheim and Rangel, 2008; Chetty et al., 2009]. This paper presents new evidence on "non-standard" behavior in the public finance domain, based on US income tax withholding patterns.

Every year approximately 100 million taxpayers (nearly 80 percent) receive a tax refund because they have overwithheld taxes in the previous year. Overwithholding generates $155 billion in annual income tax refunds—on average 7 percent of adjusted gross income (AGI) [IRS, 2004]. Many overwithholders have relatively high incomes and may view the foregone interest on their tax overpayments as a trivial loss. However, a surprising fraction of low-income tax filers have limited (or even zero) tax liability, pay relatively high interest rates to finance consumption until their refund arrives and in some cases pay additional fees to accelerate the delivery of the refund via refund anticipation loans [Berube et al., 2002; Elliehausen, 2005].

Previous studies have offered two main explanations for overwithholding: precautionary behavior in light of uncertain tax liability and asymmetric penalties [Highfill et al., 1998] and "forced savings" arising from time-inconsistent preferences and/or mental accounting [Thaler, 1994; Neumark, 1995; Fennell, 2006]. Such models typically assume that tax filers actively choose their withholdings and frequently readjust as incentives change. In contrast, I explore an additional explanation based on inertia (or incomplete adjustment). Specifically, I consider cases in which there is an external force or "shock" that changes the level of one's withholdings relative to one's tax liability, thus altering one's expected refund level. I subsequently observe to what extent tax filers respond to this external shock. I find that tax filers only partially adjust their withholdings, offsetting less than one-half of the change in their refund level after one year.

I begin by exploiting exogenous variation in withholding levels brought about by a Presidential Executive Order. In 1992, the Bush administration reduced the default level of income tax withholdings for wage earners below a specified income threshold, with the aims of stimulating the economy [Shapiro and Slemrod, 1995]. Importantly, the level of tax liability for this group remained constant. Thus, in the absence of a behavioral response, the policy would result in a reduction in the refund level or increased balance due for treated tax filers. Using the relationship between withholdings and allowances, I estimate the counterfactual level of withholdings absent any adjustment and compare this to actual levels of withholdings. I conclude that tax filers offset this policy by only 25 percent in its first year.[1]

I then consider the relationship between the number of child dependents and the refund level, using a panel of tax returns from the years 1979 to 1990. In an event study framework, I identify the change in tax liability following a change in the number of child dependents. Estimating the subsequent change in tax prepayments yields another test of the inertia hypothesis. I find that prepayments are adjusted to offset 43 percent of the change in tax

[1] Feldman [2008] uses this 1992 change in default withholdings as an instrument in identifying the effect of the timing of income on IRA savings. A key identifying assumption is that individuals do not undo the 1992 change in defaults, or rather, that tax filers are substantially inert. She shows evidence that withholdings are affected by the change in defaults. I complement her findings by decomposing this change into a mechanical effect and behavioral response and comparing the relative magnitude of the two.

liability in the first year. Three years following the shock, prepayments have adjusted to account for 58 percent of the change in tax liability. I also find suggestive evidence of heterogeneity in responses. First, it appears that tax filers are more likely to adjust their withholdings when the loss of a dependent causes an expected refund to become a balance due. In addition, it is possible that higher income tax filers adjust their withholdings more quickly.

Finally, I turn attention to the population eligible for the Earned Income Tax Credit (EITC)—a refundable tax credit that directly reduces tax liability [see Hotz and Scholz, 2003, for an overview]. Overwithholding for this group is on average 12 percent of income, which, in combination with potential borrowing constraints, may hinder the ability to smooth consumption. To test for inertia among these tax filers, I make use of variation in tax liability generated by the dramatic expansion of the EITC over the last quarter century. Using repeated cross sections of tax return data, I estimate the relationship between expected EITC amounts and average tax prepayments. I show that differential growth in EITC levels is a strong predictor of relative refund levels, which suggests that tax prepayments are not adjusted much in response to this particular reduction in tax liability. For every $1 increase in the EITC, I can rule out a response greater than $0.02 in reduced tax prepayments. Thus, there is little evidence of offsetting behavior on the part of tax filers in this group.

The empirical results can be combined with a simple model of withholding to gain a better understanding of tax filer behavior. First, it is theoretically possible that uncertainty with respect to tax liability can generate overwithholding. However, a standard model with uncertainty requires either a high level of risk aversion or unreasonable beliefs about the cost of an error in withholding to fit the data. Introducing time-inconsistent preferences provides a slightly better fit of the data for a model with uncertainty, but not by much. Alternatively, time-inconsistency in combination with a borrowing constraint may generate overwithholding. However, testing such a model of forced savings requires data on borrowing constraints, which are not available in the tax data used here. Finally, a model with costs to adjusting withholdings may explain the pattern of inertia observed. However, the prevalence of overwithholding rather than underwithholding requires more. If defaults are biased in favor of overwithholding, or if adjustment costs are asymmetric, then inertia may explain the observed patterns of withholding. As it turns out, in most cases the default withholding level is high, and the data weakly support an asymmetric response.

These findings have at least three implications. First, caution must be taken when using the observed levels of income tax refunds to generate inferences about preferences. For example, the prevalence of overwithholding has been cited as evidence of time-inconsistent preferences and/or mental accounting [Neumark, 1995; Thaler, 1994; Fennell, 2006]. However, the presence of inertia confounds such an interpretation.[2] Second, to the extent that defaults drive the behavior of inert tax payers, the decisions made by a social planner in setting default withholdings may no longer have neutral effects. Similar conclusions have been made in other arenas where default effects have been detected [Madrian and Shea, 2001; Choi et al., 2003; Johnson and Goldstein, 2003; Abadie and Gay, 2006; DellaVigna and Malmendier, 2006]. Default withholding rules in the US generally predispose individuals toward refunds. This is especially relevant for tax filers in the lower tail of the income distribution, where sizeable refundable credits and a possibly higher incidence of inertia result in a significant share of income that is overwithheld. This phenomenon may be purposeful, increasing savings for these tax filers. On the other hand, given the evidence on inertia, it might also be the case that default withholding rules generate inefficiently high amounts of tax prepayments and result in costly constraints on liquidity throughout the year.

The rest of the paper proceeds as follows. Section 2 explains the US income tax withholding system. Next, I present an empirical framework for studying inertia in Section 3.1. I then describe the data used in this study and provide descriptive statistics on overwithholding in Section 4. I present empirical results on inertia in Section 5, and Section 6 concludes with a discussion.

2 Institutional Details

In the US, individuals are taxed on income as they receive it, in a so-called "pay-as-you-earn" system. Throughout the year tax filers make prepayments either through withholdings, which are taken out of each paycheck, or through quarterly, estimated payments to the Internal Revenue Service (IRS), which typically account for non-wage sources of income. At the end of the year, annual income has been fully realized, and tax liability is determined. If tax prepayments are too low, the tax filer must pay the remaining balance, with a possible interest penalty. If prepayments are too high, tax filers receive a refund, although no interest is earned on the excess tax prepayments. Given the uncertainty involved, it may prove difficult to exactly equate prepayments to tax liability. Nevertheless, clear feedback is received every year with the filing of a tax return, in the form of a refund or balance due. Lower-income tax filers may qualify for refundable credits, which can result in a negative tax liability. In

[2] This point is similarly made by Barr and Dokko [2007].

this case, a refund is received even if tax prepayments are zero. Notwithstanding, refundable credits may be partially shifted from an end-of-the-year payment into each paycheck via the Advance EITC option [Committee on Ways and Means, 2004].

In a traditional employment setting, the employer automatically withholds tax prepayments for an employee each pay period. Employees determine the withholding amount using a W-4 form [see IRS, 2009b]. Specifically, the W-4 form involves choosing a number of allowances, which roughly reflect the anticipated number of exemptions to be claimed on the tax return. The higher the number of allowances, the lower are one's withholdings per pay period. The W-4 form provides guidelines for choosing a number of allowances based on the major factors affecting tax liability: number of dependents, deductions, marital status and number of jobs. In addition to choosing a number of allowances, tax filers may designate an additional dollar amount to be withheld from each paycheck, allowing in theory for a continuous menu of withholding amounts. Using the employee's W-4 form, the employee's level of earnings and an IRS-provided withholding schedule, the employer then computes withholdings.. A W-4 form can be resubmitted at any time should tax liability be expected to change but is generally only required at the onset of employment. In the event that an employee submits an incomplete W-4 or no W-4, the employer is required to choose zero allowances, resulting in the maximum level of withholdings [IRS, 2009a]. This default rule may help explain why prepayments are initially set high. The evidence I present below on inertia and asymmetric adjustment may help to explain why prepayments tend to remain high overtime.

3 An Empirical Model of Withholding

3.1 General Framework

I will now motivate the empirical analysis with the following simple model of income tax refunds. Consider the refund level:

$$R(A, E; Z) = P(A, E; Z) - L(A, E; Z),$$

where $R(\cdot)$, $P(\cdot)$ and $L(\cdot)$ are the refund, tax prepayment, and tax liability level respectively.[3] There are two endogenous determinants of prepayments and liabilities, A and E.

[3] See Appendix Section A.1 for a theoretical discussion of how the tax filer has arrived at this preferred level of income tax refund or balance due.

These can be thought of as the number of allowances and earnings. Finally, there is an exogenous policy parameter Z, which may represent some feature of the tax code. Now consider the change in the refund level given a change in the policy parameter Z:

$$\begin{aligned}\frac{\partial R}{\partial Z} \; = \; & \underbrace{\left(\frac{\partial P}{\partial A} - \frac{\partial L}{\partial A}\right) \cdot \frac{\partial A}{\partial Z} + \left(\frac{\partial P}{\partial E} - \frac{\partial L}{\partial E}\right) \cdot \frac{\partial E}{\partial Z}}_{\text{behavioral response}} \\ & + \underbrace{\left(\frac{\partial P}{\partial Z} - \frac{\partial L}{\partial Z}\right)}_{\text{mechanical effect}}, \end{aligned} \tag{1}$$

where the first two terms on the right-hand side constitute a behavioral response by the taxpayer and the third term, the mechanical effect, represents the direct effect of the policy change. I make the following simplifying assumptions, which are relevant to the types of policy changes that I consider:

Assumption 1 *Allowances do not affect tax liability:*

$$\frac{\partial L}{\partial A} = 0$$

Assumption 2 *Changes in tax liability and tax prepayments brought about by an earnings response are offsetting:*

$$\frac{\partial P}{\partial E} = \frac{\partial L}{\partial E}$$

Assumption 3 *The policy change either only affects tax prepayments or only affects tax liability:*

$$\textit{either } \frac{\partial P}{\partial Z} = 0 \textit{ or } \frac{\partial L}{\partial Z} = 0$$

The first assumption describes the nature of allowances. Adjusting the number of allowances only affects withholdings. The second assumption captures the nature of automatic withholdings. If earnings change, withholdings from the paycheck are automatically adjusted in much the same way as tax liability via tax withholding schedules. The marginal withholding rate is (approximately) the same as the marginal tax rate.[4] The final assumption describes a feature of the policy changes under consideration. In each case, either the default

[4]This assumption may not hold for all tax filers, especially those married filing jointly. In some of the analysis, I estimate prepayment adjustments separately for single and married tax filers.

withholding level changes with no accompanying change in tax liability, or vice versa. Using these assumptions, the change in refund level in Equation (1) simplifies to:

$$\frac{\partial R}{\partial Z} = \underbrace{\frac{\partial P}{\partial A} \cdot \frac{\partial A}{\partial Z}}_{\triangle P_B} + \underbrace{\frac{\partial P}{\partial Z}}_{\triangle P_M} \tag{2}$$

when the policy affects default withholdings, or

$$\frac{\partial R}{\partial Z} = \underbrace{\frac{\partial P}{\partial A} \cdot \frac{\partial A}{\partial Z}}_{\triangle P_B} - \underbrace{\frac{\partial L}{\partial Z}}_{\triangle L_M} \tag{3}$$

when the policy affects tax liability. Here again, the changes are decomposed into the behavioral response via tax prepayments, $\triangle P_B$, and the mechanical effects on prepayments and liabilities, $\triangle P_M$ and $\triangle L_M$, respectively. In measuring the tax filer's response to the policy change, consider the following two extreme cases:

Case 1 (Full Adjustment) *Under **full adjustment** the agent adjusts prepayments to fully offset the policy change:*

$$\frac{\partial R}{\partial Z} = 0,$$

*and thus equations (2) and (3) can be rearranged as follows to define the **adjustment rate**, $\boldsymbol{\alpha}$, i.e. the ratio of the behavioral response to the mechanical effect:*

$$\begin{aligned} \alpha_P &\equiv -\frac{\triangle P_B}{\triangle P_M} = 1 \\ \alpha_L &\equiv \frac{\triangle P_B}{\triangle L_M} = 1. \end{aligned} \tag{4}$$

Case 2 (Full Inertia) *Under **full inertia** the agent does not offset the policy change at all:*

$$\frac{\partial A}{\partial Z} = 0,$$

and thus the above adjustment rates become:

$$\alpha_P = \alpha_L = 0. \tag{5}$$

In practice, I estimate these adjustment rates by regressing an observed change in tax prepayment level on the expected mechanical change in prepayments or liabilities. Variation in the mechanical change is brought about by some policy change or other shock to the refund level, Z. Though the details of vary slightly, I generally use some variation of the following specification:

$$\triangle P_B = -\alpha_P \cdot \triangle P_M(Z) + \Gamma\mathbf{X} + \varepsilon \tag{6}$$

when the policy affects prepayments and

$$\triangle P_B = \alpha_L \cdot \triangle L_M(Z) + \Gamma\mathbf{X} + \varepsilon \tag{7}$$

when the policy affects tax liability. The vector $\mathbf{X}$ includes a group of control variables. The key identifying assumption is that conditional on $\mathbf{X}$, the policy variable Z does not directly affect the underlying target refund level, and thus only affects tax prepayments via a change in default prepayments or tax liability.

3.2 Specific Applications

I use the preceding framework to estimate an adjustment rate, α, in three different settings. In each case, there is a unique shock that affects the expected refund level. I subsequently observe the taxpayers' response to this event. In the Section 5 below, I outline the key features of the different sources of identification. In one case, the 1992 change in default withholdings, there is a change in default withholdings while holding liability constant. In the other two cases, the panel study of child dependents and the EITC expansion, tax liability changes without a compensating adjustment of default withholdings. In each case, I use a different econometric approach. I relate each of these approaches to the general empirical framework described above and also highlight the direction (up or down) in which the shock pushes the refund level in the absence of a behavioral response.

4 Data Description

4.1 Data Overview

The data used in this analysis come from the IRS Statistics of Income (SOI) Division. For almost every year since 1960, the IRS has released a public-use sample of income tax returns. Sample sizes range from 80,000 to 150,000. In addition to selected cross sections of the IRS public-use file, I use a panel of tax returns from the same source. The IRS tax panel follows a subset of tax filers from 1979 to 1990. This unbalanced, longitudinal data set contains about 45,000 observations for the first three years, and then between 10,000 and 20,000 observations in each year thereafter. The data contain detailed information on sources of income, and include most of the information provided on the IRS 1040 tax return. Most importantly, the data include tax prepayments, disaggregated into withholdings from wages and estimated tax payments, tax liability and the level of refund/balance due. Demographic information is limited to marital status, number of children, other dependents and an indicator for age equal to or above 65 years.

4.2 Descriptive Statistics

I provide summary statistics on overwithholding for tax filers in 2004 in Column (1) of Table 1. On average, individuals receive a refund of $1,000 and the median ratio of prepayment to tax liability is 1.26. In addition, refunds comprise 7 percent of AGI for the average tax filer. Finally, the share of tax filers receiving a refund is just below 80 percent. Panel A of Figure 1 depicts a skewed right distribution of refunds that visually reinforces the summary statistics. One may notice the mass of filers at a zero balance. This is mainly comprised of individuals with both zero tax liability and zero tax prepayments.[5]

Further visual evidence reveals two significant patterns of overwithholding. First, individuals claim less than the total number of allowances to which they are entitled and are also clustered at zero allowances, which is the default level set for workers by employers. Panel B of Figure 1 presents an estimated distribution of actual allowances along side a counterfactual distribution of allowances for wage earners. The former is estimated using wage and withholding data to impute the number of allowances chosen on the W-4 form.[6] The latter uses demographic information from the tax return to calculate the total number of allowances to which the individual is actually entitled. Second, we see in Panel C of Figure 1 that refunds are persistent. Here I use the 1979 -1990 panel of tax filers, calculate the share of time that a refund is received for each individual and plot the distribution of this statistic. Contrary to the idea that individuals may fluctuate between under- and overwithholding, nearly half of all tax filers always receive a refund.

[5] This discontinuity in the distribution at a zero balance may also be evidence of tax evasion.
[6] See the appendix for further details on this estimation procedure.

5 Results

5.1 1992 Change in Default Withholdings

In his 1992 State of the Union Address, President Bush announced a decrease in default withholdings aimed at stimulating a sluggish economy [Shapiro and Slemrod, 1995]. New withholdings tables were issued in February of that year and employers were instructed to incorporate the new tables as soon as possible [IRS, 1992]. The typical reduction in annual withholdings was $187 and $423 per job for single and married wage earners with taxable wages below $64,000 and $110,000 respectively.[7] Panel A of Figure 2 demonstrates the nature of the change in withholdings. Importantly, there was no concurrent reduction in tax liability. Within the framework presented of Section 3.1, Z corresponds to the default withholding rules. There is no change in tax liability due to the policy change, $\partial L/\partial Z = 0$, and thus I am estimating the adjustment rate α_P. The mechanisms, A, by which individuals offset the policy are (1) submitting a new W-4 with a lower number of allowances to raise withholdings or (2) increasing estimated payments. For this analysis, I use repeated cross section data from the IRS SOI public use samples from the years 1989 to 1992. Table 1, Column (1) provides descriptive statistics on the sample used. In terms of income and refund propensity, this sample, which represents about half of the entire tax filer population, falls somewhere between the general population of tax filers and the EITC population. Analysis here is restricted to tax filers with primarily wage and salary earnings. Those with other significant sources of income may choose allowances in a different manner than what is assumed below.

Taxpayers are made aware of the 1992 policy change through two main avenues. First, individuals receive a higher after-tax paycheck every pay period once the employer implements the change in withholdings tables. Shapiro and Slemrod [1995] find that about one-third of survey respondents noticed a reduction in withholdings a month after the policy took effect. Second, when the tax return is filed, the tax filer should receive a lower refund or owe a higher balance than usual. In addition, employers were instructed to directly notify their employees of the change in withholdings, and also to instruct them on how to offset the reduction in withholdings. The new Employer's Tax Guide reads, "If some of your employees do not want their withholding changed, they should complete new Forms W-4" [IRS, 1992].

[7] These amounts are presented in terms of year 2000 dollars and represent the maximum changes. Actual changes may vary for individuals in the phase-in or phase-out region of the withholding adjustment, as depicted in Figure 2, Panel A.

In comparison to the other shocks that I analyze, this policy change generates downward pressure on the refund level. In the absence of adjustment, the tax filer will be more likely to owe a balance at the end of the year.

I use information on the relationship between withholdings, wages and allowances to arrive at an estimate of α_P. This method of estimating the mechanical effects, behavioral responses and adjustment rates requires the following three elements:

$$\begin{aligned}
P_0\left(A_0^i, E^i\right): &\quad \text{baseline withholdings prior to the policy change} \\
P_1\left(A_0^i, E^i\right): &\quad \text{withholdings following the policy change, holding allowances fixed} \\
P_1\left(A_1^i, E^i\right): &\quad \text{withholdings after the policy change and change in allowances.}
\end{aligned}$$

where withholdings, $P(\cdot)$, are a function of allowances, A^i, and wage earnings, E^i, as described in IRS withholding tables. The 0 and 1 subscripts denote pre- and post- policy variables respectively, for the *ith* individual in 1992. I observe post-policy withholdings and earnings, and thus can infer the distribution of post-policy allowances. However, I do not observe pre-policy 1992 withholdings and thus cannot make direct inferences regarding pre-policy allowances, A_0^i. Therefore, I make the following assumption:

Assumption 4 *In the absence of the policy change, the distribution of allowances would have remained constant between 1991 and 1992:*

$$F_0\left(A_0\right)\big|_{t=91} = F_0\left(A_0\right)\big|_{t=92}$$

If this holds, I can estimate the distribution of allowances in 1991 and use this as a proxy for the pre-policy distribution of allowances in 1992. I similarly use data from 1992 to estimate the distribution of post-policy allowances in 1992, arriving at estimates of the conditional distributions, $\hat{F}_0\left(A_0|\,\boldsymbol{\theta}\right)$ and $\hat{F}_1\left(A_1|\,\boldsymbol{\theta}\right)$, where $\boldsymbol{\theta}$ is a vector containing income group and marital status.[8] Using these conditional distributions, I estimate withholdings as follows:

$$\begin{aligned}
\hat{P}_0^i\left(A_0^i, E^i\right) &= \int P_0\left(a, E^i\right)\, d\hat{F}_0\left(a|\,\boldsymbol{\theta}^i\right) \\
\hat{P}_1^i\left(A_0^i, E^i\right) &= \int P_1\left(a, E^i\right)\, d\hat{F}_0\left(a|\,\boldsymbol{\theta}^i\right) \\
\hat{P}_1^i\left(A_1^i, E^i\right) &= \int P_1\left(a, E^i\right)\, d\hat{F}_1\left(a|\,\boldsymbol{\theta}^i\right).
\end{aligned}$$

[8] Additional details regarding the estimation of these distributions are provided in an appendix.

For a given individual, then, the mechanical effect and behavioral response are defined as follows:

$$\triangle P_M^i = \hat{P}_1^i\left(A_0^i, E^i\right) - \hat{P}_0^i\left(A_0^i, E^i\right) \tag{8}$$

$$\triangle P_B^i = \hat{P}_1^i\left(A_1^i, E^i\right) - \hat{P}_1^i\left(A_0^i, E^i\right). \tag{9}$$

Finally, I use the estimated mechanical effects and behavioral responses in the following regression:

$$\triangle P_B^i = -\alpha_P \cdot \triangle P_M^i + x^i\beta + \varepsilon^i, \tag{10}$$

where x is a control variable measuring the level of tax liability. For this procedure I report both standard errors clustered within each income-by-marital cell and bootstrap standard errors.

Panel B of Figure 2 lends credence to this method. The graph shows the estimated distribution of allowances from 1990 to 1993, using the same methods as in Figure 1. First, we see that the distribution is relatively stable between 1990 and 1991, suggesting that in the absence of a policy change, the distribution of allowances would have remained constant from 1991 to 1992. We also see that the distribution shifts in 1992 in the direction toward lower allowances and thus higher withholdings, which would be expected of individuals attempting to offset the policy change. This consistent with a behavioral response beginning in 1992.

In Table 2, I estimate the fraction by which this behavioral response offsets the mechanical effect of the policy shock. Using Equation (8), I estimate an average mechanical decrease in withholdings of \$237, with conditional averages of \$181 and \$392 for single and married filers respectively. In contrast, I estimate an average behavioral response of only \$57 in additional withholdings using Equation (9). Estimating Equation (10), this translates into an estimate of 0.25 for α_P. Tax filers only offset 25 percent of the decrease in withholdings during the first year of the policy change.

One concern may be that these estimates are biased due to differential trends in prepayments across the affected and non-affected groups. To address this, I estimate Equations (8), (9) and (10) using data from years prior to the policy change. Hypothetical mechanical effects are imputed for individuals in 1990 and 1991 based on the rules of the 1992 policy change. These "placebo" estimates of α_P will pick up preexisting differences in withholding trends among those in the earlier years who would have been affected by the 1992 policy change. As seen in Table 2 Column (3), the "placebo" estimates are indistinguishable from zero.

5.2 Panel Study of Child Dependents

I further explore inertia by estimating the effect of child dependents on tax liability and tax prepayments. Adding a child increases the number of exemptions that a taxpayer can claim, reducing taxable income. In addition, tax credits such as the EITC become available for households within certain income ranges. Thus, when one either loses or gains a child dependent, tax liability will rise or fall in a predictable manner. Returning to the general empirical framework, the so-called policy variable, Z, is now the number of child dependents. While there is a change in tax liability via the number of exemptions claimed, the automatic withholding from wages does not adjust unless a new W-4 form is filed. Thus we have a case where $\partial P/\partial Z = 0$, and I am therefore estimating $\alpha_L = 0$.

To examine this phenomenon I use panel data on tax returns spanning 1979 to 1990. I perform an event study of the loss or gain of a child dependent. Following a change in the number of child dependents, tax filers receive direct feedback on the change in tax liability when the tax return is filed. The loss or gain of a child will result in a lower or higher refund level, respectively. In addition, if a new W-4 form is filed for any reason, the tax payer is explicitly directed to take into account any changes in the number of children that are claimed [IRS, 2009b]. Within this context, I can directly compare the effect of being pushed toward a refund or toward owing a balance on subsequent prepayment levels.

In Column (3) of Table 1, we see that, compared to the other cases that I consider, this sample has slightly higher incomes, owing to the restriction in data to tax filers with dependents. While 84 percent of the changes in child dependents from year to year involve one child, I pool all changes, which may include two or more dependents lost or gained. Losses and gains are equally likely to occur in the sample. Nonetheless, losses and gains of children may not be directly comparable events. The former tends to happen later in the life cycle. Furthermore, the loss of a child may be commonly preceded by a divorce or negative shock to income. I discuss these concerns in further detail below.

5.2.1 Main Estimates

I will estimate the adjustment rate within an event study framework, where the event is a change in number of child dependents. In this section those who lose and those who gain a child are pooled together. Using two stage least squares (2SLS), I estimate the following structural equation:

$$prepayment_{itk} = \alpha_L^j \cdot liability_{it} + \eta_i + \eta_t + \delta_l k_l + \delta_g k_g + \Gamma \mathbf{X}_{it} + \varepsilon_{it}. \tag{11}$$

The first stage and reduced form regressions are as follows:

$$
\begin{aligned}
liability_{itk} &= \triangle L_l^j \cdot Loss_{i,t-j} - \triangle L_g^j \cdot Gain_{i,t-j} + \tilde{\eta}_i + \tilde{\eta}_t \\
&\quad + \tilde{\delta}_l k_l + \tilde{\delta}_g k_g + \tilde{\Gamma}\mathbf{X}_{it} + \tilde{\varepsilon}_{it} \qquad (12) \\
prepayment_{itk} &= \triangle P_l^j \cdot Loss_{i,t-j} - \triangle P_g^j \cdot Gain_{i,t-j} + \acute{\eta}_i + \acute{\eta}_t \\
&\quad + \acute{\delta}_l k_l + \acute{\delta}_g k_g + \acute{\Gamma}\mathbf{X}_{it} + \acute{\varepsilon}_{it} \qquad (13)
\end{aligned}
$$

Each observation is indexed by individual, i, time t and "event time," k, i.e. the time since the event. The sample is restricted to individuals who experience a change in dependents and who are also under the age of 65. The η_i and η_t are individual and time fixed effects, while the δ's are linear trends in event time, k. The $\mathbf{X}_{it}$ are vectors of time-varying characteristics: a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status and a dummy for transitions from single to married.[9] The $Loss_{i,t-j}$ and $Gain_{i,t-j}$ are a set of dummy variables indicating that at time t a change in dependents has taken place j periods in the past, $j \in \{1, 2, 3\}$. Finally, the equations are estimated separately for each value of j.

The coefficients of interest are the α_L^j, and are interpreted as follows. For each j, the sample includes observations for three years prior to the event, the year of the event, and observations from a post year j, i.e. those for whom $k = -3, -2, -1, 0$ and j. In this case, the δ's capture trends in prepayments and liabilities in event time, and are estimated from the pre-event observations. Next, the $\triangle L^j$ and $\triangle P^j$ measure the change in liabilities or prepayments between event year $k = 0$ and event year $k = j$, conditional on the trend in event time, δ. As such, the coefficients $\triangle L_l^j$ and $\triangle L_g^j$ in equation (12) can be thought of as the mechanical effect on current tax liability of a change in child dependents j periods ago for losers and gainers respectively. Likewise, the coefficients $\triangle P_l^k$ and $\triangle P_g^k$ in (13) can be thought of as the behavioral response by taxpayers. In Table 3 I summarize these changes

[9] The sensitivity of the estimates to functional form is explored in the Appendix A.4 Table A.1. The estimates change very little whether one uses a cubic in income or a spline, whether lagged income is included, whether martial status alone is included or the more flexible specification here, and whether one includes individuals over age 65 or not. The inclusion of time trends in event time does result in an increase in the adjustment rate estimates.

using the following weighted averages:

$$\triangle L_M^j = \pi_l \cdot \triangle L_l^j + \pi_g \cdot \triangle L_g^j \quad (14)$$

$$\triangle P_B^j = \pi_l \cdot \triangle P_l^j + \pi_g \cdot \triangle P_g^j, \quad (15)$$

where π_l and π_g are the share of losers and gainers in the sample. The $\triangle L_M^j$ and $\triangle P_B^j$ are measures of the average mechanical effect and behavioral response. Finally, the parameter α_L^j measures the relative magnitude of the two. Put another way, α_L^j is the response of tax prepayments to changes in tax liability, driven by a change in number of dependents j periods ago. The 2SLS method isolates the variation in liability generated by the loss or gain of a child dependent.

Identification of α_L^j is illustrated in Figure 3. The solid line shows the level of tax liability and prepayments in a seven-year window around the event, with the event year normalized to zero. The solid lines are adjusted for the η_i, η_t and $\mathbf{X}_{it}$. As can be seen, there remains a trend in event time. This may be due to the fact that events regarding child dependents are correlated with the life cycle but a continuous measure of age is not available in the $\mathbf{X}_{it}$. The dashed lines are adjusted for the trends, i.e. the δ's, and what is left is the change in tax liability at the time that a child is gained or loss. This remaining variation is what is used to estimate $\triangle L_M^j$, $\triangle P_B^j$, and α_L^j.

In Figure 3, the points along the dotted lines are the coefficients from Equations (12) and (13). The horizontal axis measures event time and the vertical axis measures outcomes relative to the year in which the number of child dependents changes. There is a sharp increase in tax liability when a dependent is lost. The inverse is true for gains in dependents. However, we see prepayments do not change as sharply.

In Table 3, I report the point estimates underlying these figures. As can be seen in Column (1), a change in the number of dependent translates into an immediate change in tax liability of about \$550 dollars. This change in tax liability persists over the next three years. In Column (2) of Table 3, we see that the response of tax prepayments is not as large: \$238 following a change in the number of dependents. This response gradually increases over time. Finally, the adjustment rates estimated from Equation (11), α_L^j, are reported in Column (3). In the first year following the change in tax liability the adjustment rate is 0.43. Tax prepayments do not fully adjust; three years after the change in dependents, only 58 percent of the shock has been undone. It's important to note that the sample is an unbalanced panel. The construction of the IRS panel is such that it is not common for an observation to have missing years. As such, the difference in adjustment rates across years may either signify a gradual increase in adjustment or differences in samples across the three estimates.[10]

5.2.2 Heterogeneity in Responses

Though the results thus far demonstrate that tax filers have a limited response to changes in tax liability or default withholdings, inertia alone does not explain a bias toward refunds. One possibility is that there is a differential response for changes that cause the refund to decrease versus changes that cause it to increase. One can examine this hypothesis by separately estimating adjustment rates for those who lose a child and those who gain a child and seeing whether the adjustment rate is larger for the former group. Table 4 present adjustment rates separately for losers and gainers in Columns (2) and (3). The two groups have similar responses to changes in tax liability in the three years following the change in number of child dependents. If anything, losers appear to display more inertia than gainers. Thus, evidence of an asymmetric response does not show up for the general sample.

An alternative conjecture is that tax filers generally exhibit the same response to increases and decreases in tax liability, but changes near a zero balance trigger a greater reaction. Given that most tax filers initially have excess withholding, we may not pick up the effect of a zero balance in the general population. Thus, in Columns (4) and (5), I restrict the sample to tax filers that have an initial refund level or balance due less than $1,000, a so called "Zero Balance" sample. For this sample, a loss of a child dependents is likely to cause a tax filer who had previously received a refund to owe a balance due. The converse is true for a tax filer in this sample who gains a child. Now, losers have an adjustment rate between 0.93 and 1.89 in the first three years following a change in dependents, while gainers' adjustment rates are indistinguishable from zero.

The results are consistent with the idea that transitioning from receiving a refund to owing a balance is particularly noticeable to tax filers and prompts a larger response. However, this conclusion remains tentative. First, there may be unobserved differences between the general population and the "Zero Balance" sample and across losers and gainers.[11] Second, the tax

[10] It would be ideal to use a balanced sample. However, given the construction of the IRS SOI Panel it is not uncommon for observations to drop in and out of the sample over time. Restricting analysis to a subset that is present the entire 7 years leaves only 10% of the original sample. Table A.2 shows that adjustment rates for this group are higher. However, this small subset may not be representative of the larger sample.

[11] In appendix Table A.3, I compare the demographics of these groups. Gainers tend to have lower incomes than losers, probably due to life cycle effects. Furthermore, the "Zero Balance" sample is comprised of lower incomes than the general population.

filers are not uniformly distributed between a balance due of $1,000 and refund of $1,000. Within in the Zero Balance sample, it is still true for losers and gainers that a majority have a refund due in the baseline year. This implies that losers in the Zero Balance sample are much more likely to cross a zero balance threshold than gainers in this subsample. Thus, an alternative interpretation is that the response to a zero balance is not greater for losers, but rather, the likelihood of facing a zero balance is greater for losers[12].

Another possible dimension of heterogeneity may be income. We may expect higher income tax filers to respond more if the costs to adjusting withholdings are fixed and constant, concave in income or possibly decreasing in income. Alternatively, income may be correlated with other characteristics that make figuring out the tax system easier (e.g. ability, information or professional tax services). In Table 4 Column (6) the adjustment rate is interacted with income, here scaled by a little more than a standard deviation of $40,000. The pattern of results is consistent with the notion that higher income tax filers are quicker to adjust their withholdings. This difference fades to zero after three years. The evidence on this heterogeneity, however, is not conclusive, as the interaction terms are at most marginally significant.[13]

5.3 EITC Expansion

In the final case, I use the expansion of the EITC as a source of variation in tax liability. Introduced in 1975, the EITC is a tax credit available to low income, working households. The earning subsidy may constitute as much as 40 percent of income, with a maximum benefit of $5,657 in 2009. The maximum earnings thresholds are $43,279 for single filers with three or more children, $40,295 for single filers with two children, $35,463 for single filers with one child and $13,440 for single filers with no children. For married couples, the earnings threshold is relaxed by an additional $5,000. The credit is refundable–meaning once it has reduced tax liabilities to zero, the remaining credit is paid out as a transfer [see Moffitt, 2003, for an overview]. The maximum EITC amount nearly tripled during the 1990s, growing from $1,255 in 1990 to $3,888 in 2000 [Committee on Ways and Means, 2004]. For eligible households, this created a significant downward trend in tax liability over the same period. However, IRS withholding tables do not account for EITC eligibility, and the W-4 form used to determine withholdings makes no explicit mention of the need to adjust

[12] Appendix Table A.3 shows 69% of losers in the Zero Balance sample have a refund and an even larger share, 84%, of gainers in the sample have a refund.

[13] Tables (A.4) - (A.6) present additional results on heterogeneity. Interactions with marital status and number changes in child dependents yield results that are even less conclusive.

withholdings in expectation of an EITC refund.

In terms of the general framework for inertia, the policy variable, Z, is now the level of the EITC for eligible tax filers. In this case, there is a change in tax liability but no accompanying change in withholding defaults: $\partial P/\partial Z = 0$ and I am again estimating α_L. The mechanism, A, for offsetting the policy is again the lowering of withholdings through the W-4 form or the lowering of estimated payments. Individuals may also sign up for Advance EITC payments in order to offset the change in tax liability, though Jones [2010] shows that very few make use of this option. Note that this approach differs from using general changes in tax liability, for many types of tax liability are accounted for in updated withholdings tables. This is not true for the EITC.

The frequency of feedback provided by the EITC is generally at the annual level. Over time, eligible households are presented with larger and larger refunds. Further signals of EITC expansion may result from the marketing and outreach efforts of tax preparers, both free and commercial, who encourage eligible households to file a tax return and claim the EITC. An understanding of the connection between the EITC and tax liability, however, may be quite elusive for recipients. For example, EITC recipients generally do not bunch at kink points in the EITC schedule [Saez, Forthcoming], though explicitly informing individuals about the schedule may increase bunching [Chetty and Saez, 2009]. As compared to the other cases under consideration, the EITC expansion drives eligible tax filers toward receiving a larger refund in the absence of any behavioral response.

To estimate the effect of the EITC on prepayments, I make use of repeated cross sections of tax return data from 1980 to 2004. I restrict analysis to the group of tax filers eligible for the EITC. Next, tax filers are split into three further groups: EITC-eligible tax filers with zero children, one child, or two or more children. In order to account for changes in group composition that occur due to changes in EITC eligibility, income variables are adjusted to 2000 levels and EITC eligibility is based on year 2000 criteria using the National Bureau of Economic Research (NBER) Internet TAXSIM model.[14] Next, I calculate group-by-year averages and estimate the following linear model:

$$\overline{P}_{gt} = \eta_g + \eta_t - \alpha_L \cdot \overline{EITC}_{gt} + \Gamma \cdot \overline{X}_{gt} + \varepsilon_{gt}, \tag{16}$$

where g indexes the four groups, t is a year index, the η's are group and year fixed effects and $\bar{X}_{gt}$ is a vector of average observable controls including a cubic in income, tax liability,

[14] For more on the TAXSIM model see Feenberg and Coutts [1993] or visit the NBER website at `http://www.nber.org/~taxsim/`.

and the child tax credit. The outcome, $\bar{P}_{gt}$, measures average tax prepayments for group g in year t. There is a negative sign in front of α_L since $\partial liability/\partial EITC = -1$.

As shown in Column (4) of Table 1, this sample represents a little more than a quarter of the entire tax filing population and occupies a lower segment of the income distribution than the tax filers in the previous two cases. As such, the costs of overwithholding may be the greatest for this group, especially if they are facing liquidity constraints. It is surprising, then, that these tax filers are particularly prone to overwithholding. We see in Table 1 that the median tax prepayments for this group is more than twice as much as tax liability. This ties up an average of 13 percent of income in overwithholdings throughout the year. As I will show, this high propensity to overwithhold is in part due to the interaction of growing tax credits and high levels of inertia.

As demonstrated in the Panel A of Figure 4, the credit underwent significant expansions during the early 1990s, especially for families with 2 or more children. I use this variation in tax liability to test for inertia in prepayments. Panel B of Figure 4 illustrates a strong positive correlation between EITC levels and refund levels across the groups and over time. This visual evidence suggests that there was little to no adjustment of tax prepayments in response to increases in EITC levels. In Panel C of Figure 4, I have plotted tax prepayments over the same time period. Tax prepayments do not appear to decline in response to the EITC increases. During the 1990s, when the EITC underwent its most pronounced growth, the level of tax prepayments among eligible tax filers is relatively flat. In 1992 there are noticeable declines in prepayments, which, as has been shown, is due to a 1992 Executive Order. Included in this graph for comparison are a group of low-income tax filers who do not qualify for the EITC.[15] To the extent that there is a decreasing trend in tax prepayments, it is nearly identical for eligible and non-eligible tax filers. This underscores the notion that changes in tax prepayments over this period were not in response to EITC growth.

Table 5 reports the coefficients estimated from Equation (16). After controlling for a cubic in income, the tax liability and the child tax credit, the change in tax prepayments in response to EITC growth is not statistically significant. Controlling for group or time fixed effects does little to change this result, nor does splitting the sample into married and single tax filers. Thus, there is strong evidence of nearly full inertia with respect to EITC growth. I can rule out an adjustment rate, α_L, larger than 0.02.

[15] These tax filers are not included in the regressions below that are ultimately used to test for inertia.

6 Discussion and Conclusion

I observe estimates of an adjustment rate that range from nearly 0 in the case of the EITC to about 0.43 in the first year following a change in the number of dependents. The effect of these shocks on the refund level appears to persist for some time. In Table 3 we see that 3 years after a change in the number of dependents, tax filers appear to adjust prepayments by only 51 percent of the change in liability. There is also limited evidence of heterogeneity. First, there are results that suggest an asymmetric response of tax filers when going from receiving a refund to owing a balance due. This is found when comparing adjustment rates among tax filers who lose or gain a child dependent. When focusing on tax filers near the threshold of a zero balance due, the former group exhibits a larger adjustment rate.

Another pattern that emerges is that inertia is greatest among the lower-income population. First, there is evidence consistent with the idea that higher income tax filers respond more quickly when adjusting withholdings in response to a change in child dependents. Secondly, the adjustment rates among the EITC eligible population are particularly low. This is made clear in Table 5, Column (4) where I rule out an adjustment rate greater than 0.02. Note that the low adjustment rates in the case of the EITC may either be due to the low income of the sample used or the specific nature of the EITC. Nonetheless, these results are intriguing given the fact that the benefit of reducing withholdings is likely to be the greatest among lower-income tax filers, who may face liquidity constraints. At the same time, the cost of adjusting withholdings and uncertainty with respect to tax liability may also be the greatest among this group, which may more than outweigh the benefits. In any event, defaults will tend to affect outcomes the most for this group.

A model of withholding may shed some further light on tax filer behavior when combined with the empirical results above. Appendix Section A.1 discusses various approaches to modeling withholding behavior. The simplest model that generates overwithholding is a standard model with uncertain tax liability. However, calibrations reveal that in order to match the observed odds of overwithholding, one either needs a very high level of risk aversion or extreme beliefs regarding the cost of a withholding error. The fit of this model can be approved by allowing for time-inconsistent preferences, but not by much. An alternative approach combines time-inconsistent preferences with borrowing constraints to generate forced savings via overwithholding. However, a test of forced savings requires data not here available on whether a tax filer faces a borrowing constraint. A final approach introduces costs to adjusting withholding. Such a model is consistent with the presence of inertia highlighted above. However, inertia alone does not predispose tax filers to over- or underwithhold. The fact that default withholding levels tend to be high in conjunction with inertia may help explain withholding patterns. Alternatively, asymmetric adjustment costs may also explaining an overwithholding bias. The results above suggest an asymmetric response, though definitive evidence on this remains elusive.[16]

The evidence that I have documented has two additional implications. First, the observed preponderance of income tax refunds is traditionally attributed to precautionary behavior in response to uncertain tax liability or commitment savings in response to time-inconsistency. However, to disentangle these alternative theories, one must first account for the inertia that partially breaks down the link between outcomes (refund levels) and active decisions (preferences). Second, the presence of inertia changes the interpretation of default withholding rules designed by a social planner. If taxpayers fully and frequently adjust their withholdings, defaults are essentially neutral. However, the evidence presented here suggests that these default withholdings rules may actually affect outcomes such as the timing of income and perhaps the ability to smooth consumption.

Policy makers have at different times attempted to capitalize on the inertia and low salience of withholdings. A leading case is the 1992 Executive Order mentioned above. This policy relied on the assumption that taxpayers would not undo a withholdings change and furthermore spend the extra income despite having to owe back the money at the years end. Survey evidence suggests that about 43 percent did indeed do just that [Shapiro and Slemrod, 1995]. The American Recovery and Reinvestment Act of 2009 includes a tax credit that is disbursed via a reduction in withholdings, which is coupled with an equal reduction in tax liability. It has been argued that distributing stimulus payments via withholdings is more likely to stimulate demand than one-time rebate checks, since the former is less salient or subject to different mental accounting rules [Surowiecki, 2009]. Most recently, the state of California increased withholdings in November 2009 by 10 percent, with no accompanying increase in tax liability. The state's explicit aims are to fill budgetary gaps in the short run via zero-interest loans from wage earners [Goldmacher and Hennigan, 2009]. Again, the policy hinges on the assumption that taxpayers will not readjust their withholdings. In each of these cases, the affect of withholding policies on taxpayers can vary greatly.

If these withholding-based policies have differential effects, one may wonder what the distribution of costs is across incomes. The costs depend on the distribution of consumer debt, investment opportunities and credit access, which can be estimated with the Survey of Consumer Finances (SCF). I use the 2004 SCF data to impute interest rates for taxpayers in

[16] See Appendix (A.1) for more details of the various models and results.

the 2004 IRS SOI data set. Next, I calculate the opportunity cost of overwithholding in terms of lost interest, which serves as a lower bound for the cost. Table 6 shows that these costs are fairly modest at an average of $63 per year. At the other extreme, overwithholding can be much more costly if individuals cannot borrow or draw on savings to smooth consumption. As an upper bound on the cost, I calculate the welfare loss of an uneven consumption profile throughout the year due to overwithholding. Depending on the curvature of utility, these costs can be of an order of magnitude larger, with an average of about $1,000 as seen in Table 6. These types of costs, which stem from credit constraints, are most relevant for lower-income groups. As a share of income, the costs of consumption smoothing range from 14 percent among individuals in the bottom quintile of income to 1 percent for the top quintile.[17]

It is also worth noting that the status quo of a refund-biased withholding system is by no means a universal phenomenon. Consider the Working Tax Credit (WTC), the UK analog of the EITC. The WTC, similarly a tax credit for low-income workers, is disbursed on a weekly or monthly basis, and thus its timing is more similar to the Advance EITC in the US [Brewer et al., 2008]. An interesting question, then, is why and how have the UK and US systems come to be so different in the timing of refundable credits? Furthermore, do UK taxpayers share the same affinity for large income tax refund payments? In the presence of strong preferences for large refunds, we would expect to observe many UK workers demanding a lump sum payment in lieu of the more frequent WTC. However, this does not appear to be the case in the UK [Brewer et al., 2008]. Thus, identifying preferences over large refunds and determining the optimal setting of withholding defaults remains an open debate. In light of the findings presented in this study, future inquiry into the subject must account for the presence of inertia.

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[17] More details on the imputation of interest rates and calculation of consumption smoothing costs are provided in the appendix.

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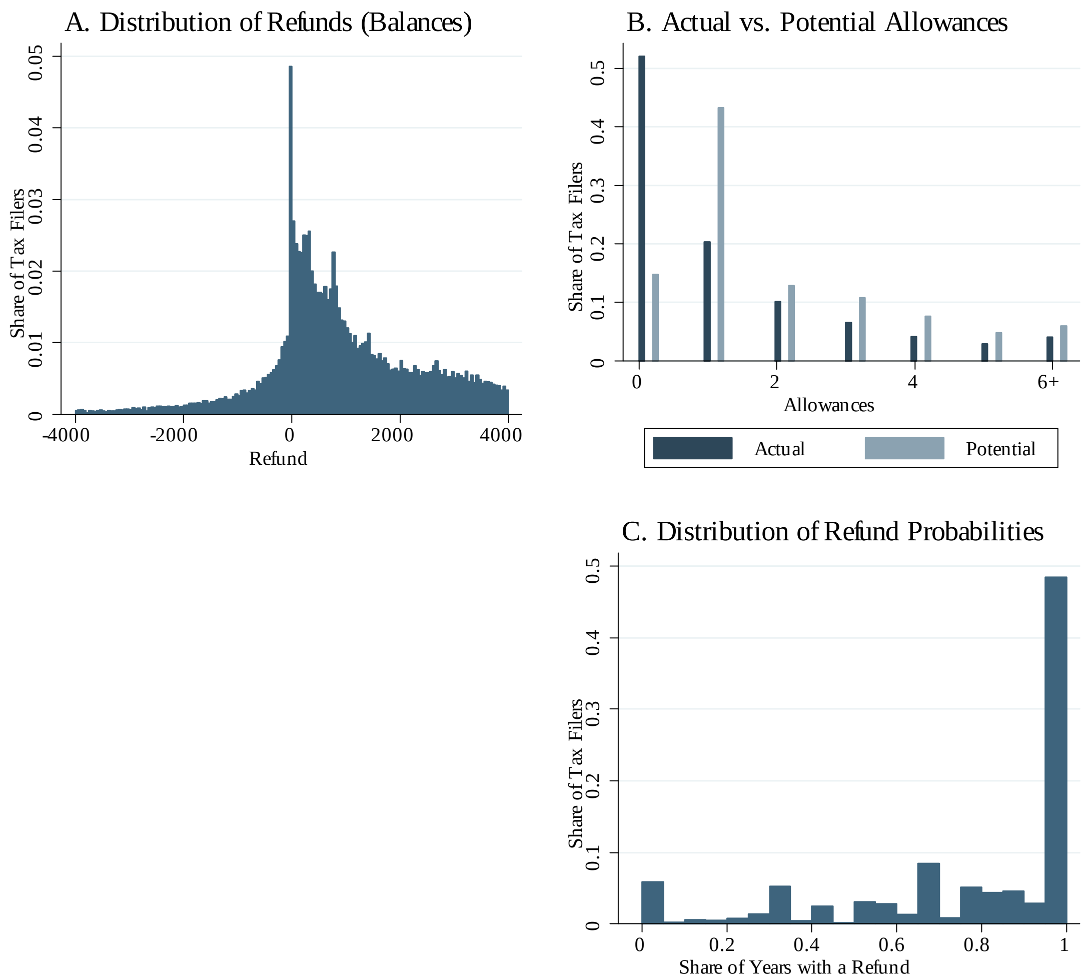
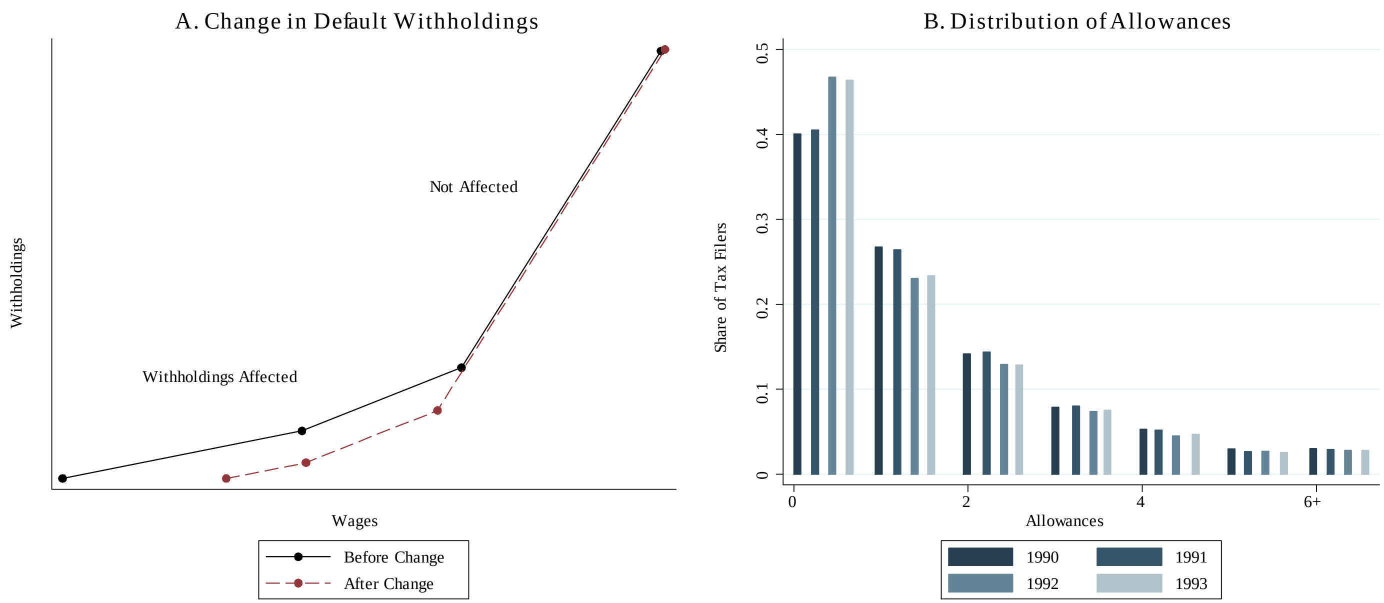
Figure 1: Descriptive Statistics



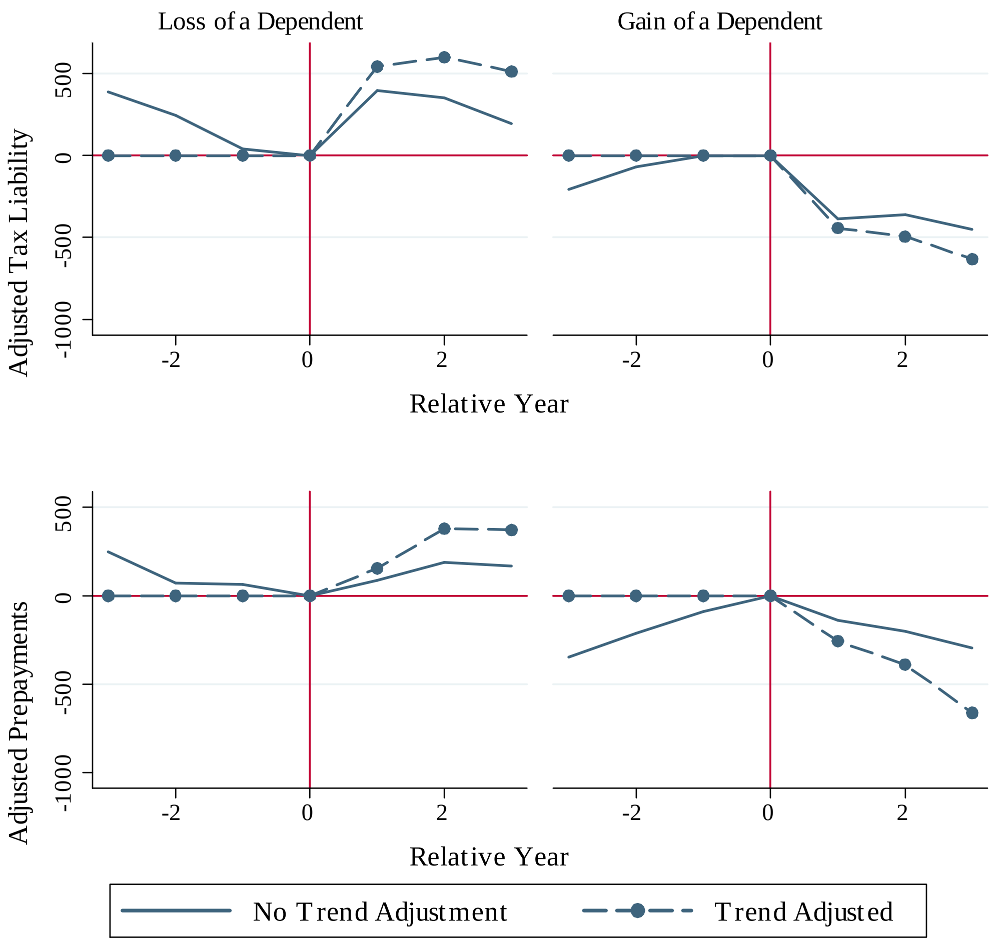
Note: (A) The distribution of refunds and balances are for US tax filers in 2004, taken from the IRS SOI public use file. (B) Actual number of allowances is estimated using the amount of withholdings reported on the tax return in conjunction with wages, marital status, AGI and IRS withholding tables. See Appendix A.2 below for further details on this procedure. Potential allowances were calculated using income and demographic information reported on the tax return in conjunction with the instructions on the W-4 form. Data are for US tax filers in 2004, taken from the IRS SOI public use file. The sample is restricted to tax filers with more than 95 percent of income from wages, who used the standard deduction and had an AGI of less than $200,000. (C) The figure presents the distribution of individual refund probabilities for US tax filers from 1979-1990, estimated using panel data from the IRS SOI public use file. Analysis is restricted to individuals with at least three years of data.

Figure 2: Effect of Default Change in Withholdings



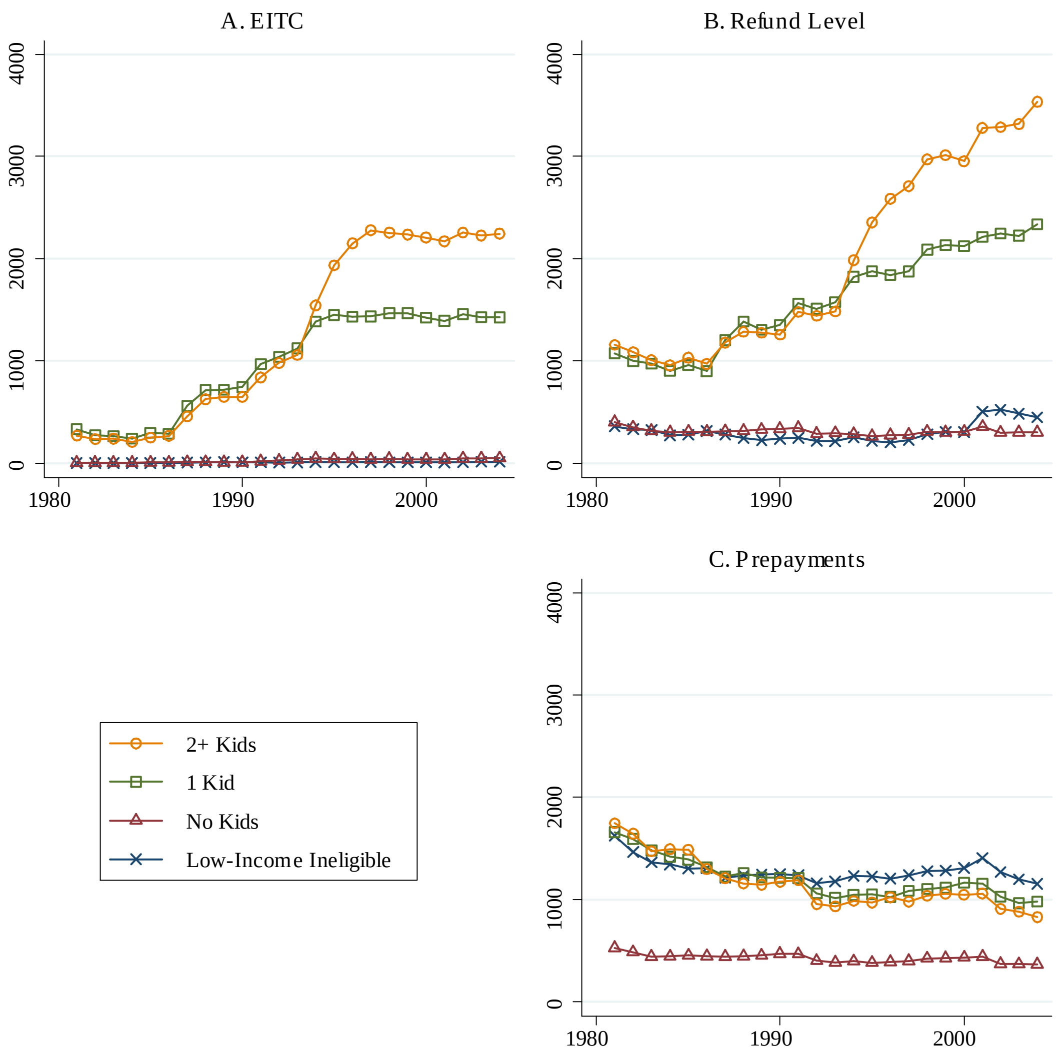
Note: (A) Graphical demonstration of the adjustments made to withholding tables following the 1992 Executive Order. (Not Drawn to Scale). (B) The distribution of allowances claimed by US tax filers for the years 1990 to 1993 is estimated using IRS SOI public use files. The sample is restricted to tax filers with more than 95 percent of income from wages, who used the standard deduction and had an AGI of less than $200,000.

Figure 3: Change in Liability and Prepayments Associated with a Change in Child Dependents



Note: The expected change in tax liability and prepayments at the time of a change in dependents is estimated using a panel of US tax filers spanning 1979 to 1990. Coefficients are obtained in an event study regression, as specified in Equations (12) and (13).

Figure 4: Mean EITC, Refund Level and Prepayments, 1980-2004



Note: Mean EITC, refund levels and prepayments are estimated for US tax filers from 1981 - 2004, using IRS SOI public use files. The first three categories include individuals who qualify for the EITC and have zero, one, or two or more children. The fourth category, "Low-income Ineligible" corresponds to individuals who have AGI below 75 percent of the maximum EITC income threshold and who do not qualify for the EITC for some other reason (e.g. age below 25, too much investment income, etc.).

Table 1: Descriptive Statistics

	(1)	(2)	(3)	(4)
	Sample Used In Analysis			
	Tax Year 2004	1992 Change in Default Withholdings	Panel Study of Child Dependents	EITC Expansion
Adjusted Gross Income				
10th Percentile	4,516	3,176	9,581	1,938
Median	27,047	18,118	37,205	8,146
90th Percentile	89,965	46,577	84,295	23,390
Mean	46,745	22,027	43,793	10,423
Standard Deviation	329,022	17,903	35,597	21,176
Refund				
Mean	1,070	775	932	1,157
Median	747	555	905	587
Prepayment to Liability Ratio				
10th Percentile	0.60	0.93	0.79	0.44
Median	1.26	1.29	1.23	2.20
90th Percentile	3.31	3.40	2.38	11.32
Refund to AGI Ratio				
Mean	0.07	0.06	0.04	0.12
Median	0.03	0.04	0.03	0.08
Refund Probability	0.79	0.88	0.80	0.93
Time Period	2004	1991-1992	1979-1990	1990-2004
Share of Total Filers	1.00	0.45	0.23	0.27
N	150,047	32,049	62,604	249,650

Note: Descriptive statistics are estimated for US tax filers using IRS SOI public use files. Dollar amounts are reported in year 2000 levels.

Table 2: 1992 Withholdings Change - Mechanical Effect, Behavioral Response and Adjustment Rate Estimates

	(1)	(2)	(3)
	Mechanical Effect: $\triangle P_M$	Behavioral Effect: $\triangle P_B$	Adjustment Rate: α_P
Full Sample	237.10	56.81	0.25
	{18.23}***	{8.85}***	{0.07}***
	[18.03]***	[8.87]***	[0.08]***
N	14,083	14,083	14,083
Single	180.88	45.14	0.30
	{13.36}***	{9.84}***	{0.05}***
	[13.2]***	[9.65]***	[0.14]**
N	9,284	9,284	9,284
Married	391.74	88.91	0.15
	{17.08}***	{16.37}***	{0.06}**
	[16.74]***	[16.22]***	[0.18]
N	4,799	4,799	4,799
Placebo 1	274.03	13.83	0.05
1991	{23.09}***	{7.61}*	{0.05}
	[22.75]***	[7.35]*	[0.05]
N	17,966	17,966	17,966
Placebo 2	235.90	−11.91	0.07
1990	{18.03}***	{8.72}	{0.06}
	[17.83]***	[8.42]	[0.07]
N	16,058	16,058	16,058

Note: Mechanical effects, behavioral responses and adjustment rates are estimated using Equations (8), (9) and (10). Data are from the repeated cross sections of the 1989-1992 IRS SOI public use files. The sample is restricted to tax filers with more than 95% of income originating from wages or salary. The mechanical effect for Placebo samples reports the hypothetical effect had the policy change taken place in earlier years. Standard errors, clustered at the income group-by-marital status level are reported in braces, while bootstrap standard errors are reported in brackets. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table 3: Change in Child Dependents - Mechanical Effect, Behavioral Response and Adjustment Rate Estimates

	(1)	(2)	(3)
	Mechanical Effect: $\triangle L_M$	Behavioral Response: $\triangle P_B$	Adjustment Rate: α_L
Year 1	550.02	238.47	0.43
	(30.66)***	(42.65)***	(0.07)***
N	51,688	51,688	51,688
Year 2	575.18	392.14	0.57
	(46.41)***	(61.67)***	(0.09)***
N	45,143	45,143	45,143
Year 3	556.70	564.44	0.58
	(63.38)***	(80.14)***	(0.09)***
N	38,902	38,902	38,902

Note: Estimates of mechanical effect, behavioral response and adjustment rate are obtained using Equations (11)-(15). Data are from a panel of US tax filers from the years 1979-1990. Controls include a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status, a dummy for transitions from single to married, individual and time fixed effects and a trend in event time. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table 4: Change in Child Dependents - Heterogeneity in Adjustment Rates

	(1)	(2)	(3)	(4)	(5)	(6)
		Full Sample		Zero Balance Sample		Interacted
	Baseline	Loss	Gain	Loss	Gain	w/ AGI
Year 1						
α_L	0.43	0.29	0.58	0.93	-0.03	0.23
	(0.08)***	(0.13)**	(0.14)***	(0.17)***	(0.07)	(0.27)
α_L x AGI	-	-	-	-	-	0.14
(unit = $40K)						(0.08)*
N	51,688	24,084	25,686	9,074	12,424	51,688
Year 2						
α_L	0.57	0.63	0.78	1.99	0.01	0.36
	(0.09)***	(0.17)***	(0.22)***	(0.41)***	(0.10)	(0.27)
α_L x AGI	-	-	-	-	-	0.09
(unit = $40K)						(0.07)
N	45,143	21,288	21,970	7,891	10,372	45,143
Year 3						
α_L	0.58	0.73	1.05	1.89	0.13	0.56
	(0.09)***	(0.28)***	(0.23)***	(0.42)***	(0.12)	(0.20)***
α_L x AGI	-	-	-	-	-	0.00
(unit = $40K)						(0.04)
N	38,902	18,438	18,570	6,813	8,825	38,902

Note: Estimates of the adjustment rate are obtained using Equations (11) - (13), with the addition of an interaction term with AGI. The "Zero Balance" sample is restricted to tax filers with a refund or balance due less than $1,000 in the base year. Data are from a panel of US tax filers from the years 1979-1990. Controls include a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status, a dummy for transitions from single to married, individual and time fixed effects and a trend in event time. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table 5: EITC Expansion - Adjustment Rate Estimates

	(1)	(2)	(3)	(4)
	Adjustment Rate: α_L			
Full Sample	-0.34	0.05	0.00	-0.06
	$(0.03)^{***}$	(0.04)	(0.04)	$(0.04)^{*}$
Share of EITC filers	1.00	1.00	1.00	1.00
Single	-0.32	0.05	0.06	0.00
	$(0.03)^{***}$	$(0.03)^{*}$	(0.04)	(0.03)
Share of EITC filers	0.83	0.83	0.83	0.83
Married	-0.12	0.06	0.06	0.01
	$(0.06)^{**}$	$(0.03)^{**}$	$(0.03)^{*}$	(0.03)
Share of EITC filers	0.17	0.17	0.17	0.17
Controls	No	Yes	Yes	Yes
Group Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	72	72	72	72

Note: The effect of the EITC changes on prepayments is estimated using data for US tax filers from the years 1981-2004. Tax filers are aggregated by year into three groups of EITC-eligible tax filers depending on number of children. Controls include a cubic in AGI, level of child tax credit and tax liability. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively.

Table 6: Average Private Cost of Incorrect Withholding by Income Quintile

	(1)	(2)	(3)	(4)	(5)	(6)
	Adjusted Gross Income					
	$0 to $11,010	$11,010 to $22,650	$22,650 to $39,530	$39,530 to $69,590	Above $69,590	Full Sample
Interest Costs:	$20	$78	$87	$91	$41	$63
Consumption Smoothing Costs:						
$\gamma = 1$	$389	$850	$572	$523	$1,051	$677
$\gamma = 2$	$525	$1,166	$870	$843	$1,643	$1,009
$\gamma = 3$	$546	$1,314	$1,051	$1,052	$2,018	$1,196
$\gamma = 4$	$589	$1,405	$1,177	$1,214	$2,334	$1,343

Note: The first row reports the cost in terms of lost interest. The next four rows report the equivalent variation of deviating from a constant monthly consumption profile to one where income timing is distorted by overwithholding and agents face borrowing constraints. The four cases vary by the curvature of utility as parameterized by the coefficient of relative risk aversion, γ. More details are provided in Appendix A.3.

A Appendix

A.1 Modeling Withholding Behavior

A.1.1 Baseline Model

A simple approach to modeling withholding behavior is with a two-period model. In period one, the agent receives income, w_1, and makes a tax prepayment, $\hat{\tau}$. In addition, savings are determined, s. The remaining income is consumed. In period two, the agent receives income, w_2 and interest on savings. In addition, actual taxes, τ_0, are paid. If the prepayment is higher than actual tax liability, a refund is received. If the prepayment is lower than actual tax liability, the differenced is paid, and an additional penalty, π is levied on the underpaid tax liability. Prepayments are restricted to being non-negative. The maximization problem can be summarized as follows:

$$\begin{aligned} \max_{s,\hat{\tau}} U &= u(w_1 - s - \hat{\tau}) + \delta \cdot u\Big(w_2 + (1+r)\,s - \big(1+\pi(\hat{\tau})\big)(\tau_0 - \hat{\tau})\Big) \qquad \text{(A.1)} \\ \text{s.t. } \hat{\tau} &\geq 0 \end{aligned}$$

where

$$\pi(\hat{\tau}) = \begin{cases} \pi & \text{if } \hat{\tau} < \tau_0 \\ 0 & \text{if } \hat{\tau} \geq \tau_0, \end{cases}$$

where $u(\cdot)$ is an increasing and strictly concave function and δ is the per-period discount factor. In this simple set up, the decision boils down to deciding which of two riskless assets to use for savings. One through the private sector and the other through withholdings. The returns to these assets are r, the interest rate, and π, the savings in avoided penalties, respectively. The latter effectively has a cap of τ_0. Actually, withholdings are allowed to exceed τ_0, but at that point, there is no longer a benefit of avoiding penalties. The solution can be summarized by the following:[18]

s^* satisfies:

$$u'(w_1 - s^* - \hat{\tau}^*_{Base}) = \delta(1+r) \cdot u'\Big(w_2 + (1+r)\,s^* - (1+\pi)(\tau_0 - \hat{\tau}^*_{Base})\Big)$$

and $\hat{\tau}^*_{Base}$, the level of withholding chosen in this baseline example is as follows:

[18] I have omitted a fourth and not very interesting case where $\pi = r = 0$.

$$\hat{\tau}^*_{Base} = \begin{cases} 0 & \text{if } \pi < r \\ \tau_0 & \text{if } \pi > r \\ [0, \tau_0] & \text{if } \pi = r. \end{cases} \tag{A.2}$$

Note that in this simple setup, there are no intentional refunds. One exception arises when the interest rate is zero or negative. This may capture situations where a secure source of saving is not available, when other benefits are means tested based on after-tax income, or when cash-on-hand is exposed to intra-household bargaining. The majority of these cases are probably more relevant for lower income tax filers, who are most likely to overwithhold. Nevertheless, overwithholding is prevalent even among middle-income households.

A.1.2 Baseline Model with Borrowing Constraints

In this section, we explore the effect of a borrowing constraint on withholding in the baseline case. This will be useful for comparison with the case below of borrowing constraints under time-inconsistent preferences. The borrowing constraint is captured by introducing an additional constraint:

$$s \geq 0.$$

Now, the first order condition for saving is:

$$s : -u'\left(c_1^*\right) + \delta\left(1+r\right)u'\left(c_2^*\right) \leq 0 \tag{A.3}$$

where the conditions hold with equality when $s^* > 0$ and

$$\begin{aligned} c_1^* &= w_1 - s^*_{BC} - \hat{\tau}^*_{BC} \\ c_2^* &= \begin{cases} w_2 + (1+r)\, s^*_{BC} - (1+\pi)\left(\tau_0 - \hat{\tau}^*_{BC}\right) & \text{if } \hat{\tau}^*_{BC} < \tau_0 \\ w_2 + (1+r)\, s^*_{BC} - \left(\tau_0 - \hat{\tau}^*_{BC}\right) & \text{if } \hat{\tau}^*_{BC} \geq \tau_0. \end{cases} \end{aligned}$$

In this case, when savings are positive, the optimal withholding level is the same as in the case of no borrowing constraints, and $\hat{\tau}^*_{BC} = \hat{\tau}^*_{Base}$. Here the subscript denotes withholding under a borrowing constraint. Alternatively, when savings equal zero the borrowing constraint is binding. Now, the tax filer may be willing to reduce withholdings, i.e. borrow from the IRS depending on the penalty rate π. First, if $\pi \leq r$, then $\hat{\tau}^*_{BC} = 0$. In the case that $\pi > r$ there are two possibilities. If the following condition holds:

$$u'\left(w_1 - \tau_0\right) \leq \delta\left(1+\pi\right)u'\left(w_2\right)$$

then $\hat{\tau}^*_{BC} = \tau_0$. Otherwise, $\hat{\tau}^*_{BC}$ satisfies

$$u'\left(w_1 - \hat{\tau}^*_{BC}\right) \leq \delta\left(1+\pi\right)u'\left(w_2 - \left(1+\pi\right)\left(\tau_0 - \hat{\tau}^*_{BC}\right)\right)$$

and $\hat{\tau}^*_{BC} < \tau_0$. Thus, the introduction of a borrowing constraint weakly reduces withholding relative to the baseline case, $\hat{\tau}^*_{BC} \leq \hat{\tau}^*_{Base}$. We will see that this prediction does not always hold in the case of time-inconsistent preferences.

A.1.3 Baseline Model with Uncertainty

Under full certainty, the tax filer never intentionally overwithholds. However, when tax liability becomes uncertain, precautionary motives may lead to overwithholding. Assume that tax liability is unknown in period 1, but it's distribution, $F(\cdot)$ with support $[\underline{\tau}, \overline{\tau}]$ is known. Now, the maximization problem is:

$$\begin{aligned}
\max_{s,\hat{\tau}} \mathbb{E}\left[U\right] &= u(w_1 - \tau - s) + \delta\left[\int_{\hat{\tau}}^{\overline{\tau}} u\Big(w_2 + (1+r)\,s - (1+\pi)\,(t_0 - \hat{\tau})\Big)\ dF\left(t_0\right)\right. \\
&\quad \left. + \int_{\underline{\tau}}^{\hat{\tau}} u\Big(w_2 + (1+r)\,s - (t_0 - \hat{\tau})\Big)\ dF\left(t_0\right)\right] \\
\text{s.t. } \hat{\tau} &\geq 0
\end{aligned}$$

The first order conditions for savings and tax prepayments are now:

$$s: \quad -u'\left(c_1^*\right) + \delta\left(1+r\right)\cdot \textstyle\int_{\underline{\tau}}^{\overline{\tau}} u'\left(c_2^*\right) dF\left(t_0\right) \quad = 0 \tag{A.4}$$

$$\hat{\tau}: \quad -u'\left(c_1^*\right) + \delta\left[\textstyle\int_{\underline{\tau}}^{\overline{\tau}} u'\left(c_2^*\right)\ dF\left(t_0\right) + \pi \int_{\hat{\tau}^*_U}^{\overline{\tau}} u'\left(c_2^*\right) dF\left(t_0\right)\right] \quad \leq 0 \tag{A.5}$$

where the second condition holds with equality if $\hat{\tau}^*_U > 0$, and c_1^* and c_2^* are defined as before. Here the U subscript denotes withholding under uncertainty.

With the introduction of the uncertainty, the choice of prepayment is no longer a binary outcome (i.e. 0 or τ_0). Furthermore, the level of risk aversion affects the agent's decision. When $\hat{\tau}^*_U > 0$, we can equate (A.4) and (A.5) and rearrange terms to obtain the following expression for the likelihood of receiving a refund, $F(\hat{\tau}_U^*)$:

$$F(\hat{\tau}_U^*) = 1 - \frac{r\mathbb{E}[u'(c_2^*)]}{\pi\mathbb{E}[u'(c_2^*)|\, \tau_0 > \hat{\tau}_U^*]}. \tag{A.6}$$

Since c_2^* is lower when $\tau > \hat{\tau}_U^*$ and utility is concave, the probability of receiving a refund increases with the curvature of $u(\cdot)$. Furthermore, let us denote the threshold $\underline{\pi}$. We can see from (A.4) and (A.5) that a necessary condition for $\hat{\tau}_U^* > 0$ is that $\pi > \underline{\pi} = r$.[19] Finally, note that (A.6) can be seen as a more generalized version of a result shown by Highfill et al. [1998]. They present a model with risk-neutral preferences. In the case of risk-neutral preferences, (A.6) reduces to: $F(\hat{\tau}^*) = (\pi - r)/\pi$. This is identical to the result of Highfill et al. [1998], where the penalty rate is set to $\pi' = \pi + r$.

A.1.4 Baseline Model with Transactions Costs

We return to the initial model with no uncertainty, but now we introduce a fixed cost of adjusting withholdings. In this case, high transactions costs may cause an individual to underwithhold or overwithhold. The thought experiment is as follows: If we endow an agent with a withholding level, will they find it worthwhile to adjust their withholding? We will assume that the individual faces an additive disutility of adjustment, φ_i. The answer depends on whether the optimal prepayment absent adjustment costs, $\hat{\tau}^*|_{\varphi=0}$, is 0 or τ_0. The answer also depends on whether the endowed level of withholding will result in a refund or balance due, τ^R and τ^B respectively.

First consider the case where absent adjustment costs, the individual would make full prepayments: $\hat{\tau}^*|_{\varphi=0} = \tau_0$. Now, let us endow the agent with a prepayment of $\tau^R > \tau_0$, such that $\left|\tau^R - \tau_0\right| = \triangle\tau$. Inaction will result in a refund, hence the superscript. In effect, if the taxpayer takes no action, it is as if she was forced to give a zero interest loan of size $\triangle\tau$ to the government. Thus, if we denote $W_0|_{\hat{\tau}^*=\tau_0} = w_1 + \frac{w_2}{1+r} - \tau_0$ as the baseline level of after-tax wealth absent this forced loan, then the agent will change the default withholding level if:

$$V(W_0) - V\left(W_0 - \frac{r\triangle\tau}{1+r}\right) > \varphi_i,$$

where $V(\omega)$ is the indirect utility function associated with (A.1), given an after-tax level of

[19] To see this, assume that $\hat{\tau}_U^* > 0$ and that $\pi < r$. We can use the fact that $\int_{\hat{\tau}_U^*}^{\overline{\tau}} u'(c_2^*)\, dF(t_0) \leq \int_{\underline{\tau}}^{\overline{\tau}} u'(c_2^*)\, dF(t_0)$ to show that $\pi < r$ implies (A.5) < (A.4). However, due to the Kuhn-Tucker conditions, (A.5) < (A.4) = 0 implies that $\hat{\tau}_U^* = 0$, which is a contradiction.

wealth ω.

Instead suppose that the endowed payment is below the tax level, so that no action will result in a balance due and penalty. That is $\tau^B < \tau_0$ and $\left|\tau^B - \tau_0\right| = \triangle\tau$, where the superscript now denotes a default balance due. Here, it is as if the agent is force to take a loan of size $\triangle\tau$ from the government at an interest rate of π. Now, the agent will change the withholding level if:

$$V\left(W_0\right) - V\left(W_0 - \frac{\left(\pi - r\right)\triangle\tau}{1+r}\right) > \varphi_i.$$

Alternatively, assume that absent adjustment costs, the individual would make no prepayments: $\hat{\tau}^*\big|_{\varphi=0} = 0$. Consider an identical experiment as in the previous two cases. If the endowed prepayment would result in a refund, the individual will change the default withholding level if:

$$V\left(W_0\right) - V\left(W_0 - \frac{r\tau^R - \pi\tau}{1+r}\right) > \varphi_i,$$

where now $W_0|_{\hat{\tau}^*=0} = w_1 + \frac{w_2}{1+r} - \frac{(1+\pi)\tau_0}{1+r}$. Withholdings will be changed with a low endowment if:

$$V\left(W_0\right) - V\left(W_0 - \frac{\left(r - \pi\right)\tau^B}{1+r}\right) > \varphi_i.$$

The withholding level is more likely to deviate from the default in each case the greater the inconvenience of the default. With respect to a bias towards receiving refunds or owing a balance, one is more likely to adjust withholdings in the event of an endowed balance due, *ceteris paribus*, if $\pi - r > r$. Intuitively, when one gives an interest free loan to the government via overwithholding, what's lost is the interest that could otherwise be gained: r. On the other hand, when one is forced to take a loan from the government via lower withholdings, the interest charged on this loan is π. However, the amount borrowed can be save, earning an interest rate of r, hence the quantity $\pi - r$ on the left hand side of the inequality. In the event that the inequality holds, an overwithholding is less costly than underwithholding. Whether or not this condition is realistic depends on the actual penalty and interest rate faced by taxpayers.

Asymmetric adjustment costs can be introduced by allowing φ_i to vary with the position of the endowed balance relative to some reference point, such as no balance. In general, heterogeneity in inertia may be driven by heterogeneity in adjustment costs φ_i. For example, if φ_i is constant, then inertia will be decreasing in income. On the other hand, if φ_i is proportional to W_0, then inertia may be relatively constant across income groups.

A.1.5 Time-Inconsistency and Forced Savings

Besides a precautionary motive or inertia, an alternative explanation for overwithholding involves Time-inconsistency and forced savings. Time-inconsistency will be modeled with sophisticated "$\beta\delta$" preferences [Laibson, 1997]. We will first show that time-inconsistency alone will not generate forced savings and then consider two modifications that, along with time-inconsistency, may result in forced savings. In order to demonstrate time-inconsistency with "$\beta\delta$" preferences one needs at least three time periods. Thus, we will begin with the baseline model of Section A.1.1 with the following modification: the level of withholding, $\hat{\tau}_\beta$, will be chosen in a pre-period, Period 0 (here the β subscript indicates the level of withholding chosen under $\beta\delta$ preferences). In Period 1, the individual makes a savings decision conditional on the level of withholdings, and Period 2 is carried out as before. Because preferences are time-inconsistent, the decision maker will be treated as different "selves" in each period, as preferences systematically change over time.

Working through backward induction, there are no choices made in the final period. Returns to savings are received, taxes and penalties are paid, and the remainder is consumed. In Period 1, the individual makes a decision similar to (A.1), except that the only choice variable is s. Furthermore, since we are now dealing with "$\beta\delta$" preferences, the discount factor used in the Period 1 decision problem is slightly different:

$$\max_{s}\ U_1 = u(w_1 - s - \hat{\tau}) + \beta\delta \cdot u\Big(w_2 + (1+r)\,s - \big(1+\pi\,(\hat{\tau})\big)\,(\tau_0 - \hat{\tau})\Big). \tag{A.7}$$

The choice of withholdings, $\hat{\tau}_\beta$ is now made in Period 0 and solves the following optimization problem:

$$\begin{aligned} \max_{\hat{\tau}}\ U_0 &= u(w_1 - s\,(\hat{\tau}) - \hat{\tau}) \\ &\quad +\delta \cdot u\Big(w_2 + (1+r)\,s\,(\hat{\tau}) - \big(1+\pi\,(\hat{\tau})\big)\,(\tau_0 - \hat{\tau})\Big). \end{aligned} \tag{A.8}$$

$$\begin{aligned} &\text{s.t.:} \\ \hat{\tau} &\geq 0 \\ u'(w_1 - s\,(\hat{\tau}) - \hat{\tau}) &= \beta\delta\,(1+r)\cdot u'\Big(w_2 + (1+r)\,s\,(\hat{\tau}) - \big(1+\pi\,(\hat{\tau})\big)\,(\tau_0 - \hat{\tau})\Big). \end{aligned} \tag{A.9}$$

The additional constraint is the first order condition of (A.7). It takes into account the fact that in Period 1, savings will be chosen as an optimal response to the level of withholding, hence the $s(\hat{\tau})$. Also, note the time-inconsistency: in Period 0, the discount factor between Periods 1 and 2 is δ, while in Period 1, the discount factor $\beta\delta$ places a smaller weight on Period 2 relative to Period 1. Forced savings involves action taken by the Period 0 decision maker to bring Period 1 decisions closer in line with Period 0 preferences. Specifically, we will refer to forced savings as a higher level of withholding, chosen by the Period 0 self than what would have been chosen by the Period 1 self (i.e $\hat{\tau}^*_\beta > \hat{\tau}^*_{Base}$).

The solution to the baseline model with $\beta\delta$ preferences will be the same as in the previous case in Section A.1.1. To see this recall that the decision to withhold 0 or τ_0 in Section A.1.1 is one of wealth maximization. Any deviation from this choice, for instance a higher level of withholdings, will simply reduce the net present value of wealth for the Period 1 decision maker. This will in turn lead to a reduction in Period 1 consumption. One may think this is the goal of choosing a higher level of withholding in Period 0. However, the Euler equation in (A.9) must still hold. As Period 1 consumption is reduced, so must Period 2 consumption be reduced. This reduction in consumption levels decreases the Period 0 objective function (A.8). Thus, the Period 0 decision maker chooses the same level of withholding as would the Period 1 "self," and no forced savings nor overwithholding take place. The key is that the Period 1 self can just undo the Period 0 decision by dissaving, and thus the forced saving method is ineffective.

A.1.6 Time-Inconsistency with Borrowing Constraints

What is needed to generate a forced savings results is some friction in Period 1 self's ability to offset overwithholding by dissaving. One possible source of friction is a borrowing constraint. Suppose, as earlier, we introduce an additional constraint on the Period 1 self's maximization problem in Section A.1.4:

$$s \geq 0.$$

Now, the constraint for the Period 0 decision is slightly altered:

$$u'(w_1 - s(\hat{\tau}) - \hat{\tau}) \geq \beta\delta(1+r) \cdot u'\Big(w_2 + (1+r)s(\hat{\tau}) - \big(1+\pi(\hat{\tau})\big)(\tau_0 - \hat{\tau})\Big).$$

The Period 0 self can potentially use a binding borrowing constraint to gain some leverage on Period 1 and Period 2 outcomes. As $\hat{\tau}$ is increased by the Period 0 self, the Period 1 self will reduce s. Denote $\tilde{\tau}$ as the level of withholding at which dissaving hits the borrowing constraint: i.e. $s(\hat{\tau}) = 0 \; \forall \hat{\tau} \geq \tilde{\tau}$. Note that if the Period 0 self raises withholding beyond this level, then she completely dictates the levels of consumption in Period 1 and Period 2. In particular, if

$$u'(w_1 - \tilde{\tau}) < \delta(1 + \pi(\tilde{\tau}))\, u'(w_2 + (1 + \pi(\tilde{\tau}))(\tau_0 - \tilde{\tau}))$$

then there will be forced savings, in that $\hat{\tau}_{\beta,BC} \geq \hat{\tau}_{Base}$, where $\hat{\tau}_{\beta,BC}$ is the level of withholding chosen by a tax filer with $\beta\delta$ preferences who is facing a borrowing constraint. Furthermore, if $\tilde{\tau} \leq \tau_0$, and $u'(w_1 - \tau_0) < \delta u'(w_2)$ then we will have $\hat{\tau}_{\beta,BC} \geq \tau_0$, i.e. intentional over-withholding. As mentioned earlier, with time-consistent preferences, the introduction of a borrowing constraint weakly reduces withholding, while in the time-inconsistent case, the effect is ambiguous.

A.1.7 Time-Inconsistency and Uncertainty

Another source of friction for the Period 1 decision can be found in uncertainty. Without a certain level of tax liability, the Period 1 self will not completely offset higher withholdings due to risk aversion. Even though the Period 1 self discounts Period 2 consumption more than the Period 0 self, she still takes into account Period 2 outcomes and will leave some precautionary savings for Period 2. The maximization problem for the Period 0 self can now be characterized as follows:

$$\begin{aligned}
\max_{\hat{\tau}} \mathbb{E}[U]_0 &= u(w_1 - s(\hat{\tau}) - \hat{\tau}) \\
&\quad + \delta\left[\int_{\hat{\tau}}^{\overline{\tau}} u\Big(w_2 + (1+r)\, s(\hat{\tau}) - (1+\pi)(t_0 - \hat{\tau})\Big)\, dF(t_0)\right. \\
&\qquad \left. + \int_{\underline{\tau}}^{\hat{\tau}} u\Big(w_2 + (1+r)\, s(\hat{\tau}) - (t_0 - \hat{\tau})\Big)\, dF(t_0)\right] \\
\text{s.t.} &: \\
\hat{\tau} &\geq 0 \\
u'(w_1 - s(\hat{\tau}) - \hat{\tau}) &= \beta\delta(1+r) \cdot \int_{\underline{\tau}}^{\overline{\tau}} u'\Big(w_2 + (1+r)\, s(\hat{\tau}) - (1+\pi)(t_0 - \hat{\tau})\Big) dF(t_0),
\end{aligned} \tag{A.10}$$

where the second constraint again accounts for the savings decision of the Period 1 self in response to the level of withholding. Note again that the Period 1 self has a different discount factor between Period 1 and Period 2. The first order condition for withholding will now be:

$$\begin{aligned} u'\left(c_1^*\right)\left[1+s'\left(\hat{\tau}^*_{\beta,U}\right)\right] &\geq \delta\left[\left[1+(1+r)\,s'\left(\hat{\tau}^*_{\beta,U}\right)\right]\int_{\underline{\tau}}^{\overline{\tau}} u'\left(c_2^*\right)\ dF\left(t_0\right)\right. \\ &\left.+\pi\int_{\hat{\tau}^*_{\beta,U}}^{\overline{\tau}} u'\left(c_2^*\right)dF\left(t_0\right)\right], \qquad \text{(A.11)} \end{aligned}$$

where the condition holds with equality if $\hat{\tau}^*_{\beta,U}>0$ (the β,U subscript denotes withholdings with $\beta\delta$ preferences and uncertainty). Similar to before

$$\begin{aligned} c_1^* &= w_1 - s\left(\hat{\tau}^*_{\beta,U}\right)-\hat{\tau}^*_{\beta,U} \\ c_2^* &= \begin{cases} w_2+(1+r)\,s\left(\hat{\tau}^*_{\beta,U}\right)-(1+\pi)\left(t_0-\hat{\tau}^*_{\beta,U}\right) & \text{if } \hat{\tau}^*_{\beta,U}<t_0 \\ w_2+(1+r)\,s\left(\hat{\tau}^*_{\beta,U}\right)-\left(\tau_0-\hat{\tau}^*_{\beta,U}\right) & \text{if } \hat{\tau}^*_{\beta,U}\geq t_0. \end{cases} \end{aligned}$$

We now have an analog to (A.6) in the case of $\beta\delta$ preferences. Substituting (A.10) into (A.11), we have

$$F\left(\hat{\tau}^*_{\beta,U}\right)=1-\frac{\tilde{r}\left(\beta\right)\cdot\mathbb{E}\left[u'\left(c_2^*\right)\right]}{\pi\mathbb{E}\left[u'\left(c_2^*\right)\middle|\,\tau_0>\hat{\tau}^*_{\beta,U}\right]}, \qquad \text{(A.12)}$$

when $\hat{\tau}^*_{\beta,U}>0$. The new term $\tilde{r}\left(\beta\right)$ is defined as:

$$\begin{aligned} \tilde{r}\left(\beta\right) &= \beta r-(1-\beta)\left[1+(1+r)\,s'\left(\hat{\tau}^*_{\beta,U}\right)\right] \qquad \text{(A.13)} \\ &= r\cdot\left(\frac{u''\left(c_1^*\right)+\quad\beta\delta\left(1+r\right)^2\mathbb{E}\left[u''\left(c_2^*\right)\right]\left(\beta+(1-\beta)\,\frac{\pi}{r}\lambda\right)}{u''\left(c_1^*\right)+\quad\beta\delta\left(1+r\right)^2\mathbb{E}\left[u''\left(c_2^*\right)\right]}\right), \qquad \text{(A.14)} \end{aligned}$$

and

$$\lambda=\frac{\int_{\hat{\tau}^*_{\beta,U}}^{\overline{\tau}} u''\left(c_2^*\right)dF\left(t_0\right)}{\int_{\underline{\tau}}^{\overline{\tau}} u''\left(c_2^*\right)\ dF\left(t_0\right)}<1.$$

The second line (A.14) follows from starting with (A.10), using the implicit function theorem to solve for $s'\left(\hat{\tau}^*_{\beta,U}\right)$ and substituting into (A.13). First, note that $\tilde{r}\left(1\right)=r$, i.e. when $\beta=1$, preferences are time-consistent and (A.12) collapses to (A.6). Second, we use similar logic as in Section A.1.3 to show a necessary condition for positive withholdings, $\hat{\tau}^*_{\beta,U}>0$, is

$\pi > \tilde{r}(\beta)$. This condition can be rewritten as

$$\begin{aligned} \pi &> \underline{\pi}_{\beta} \\ &= r \cdot \left(\frac{u''(c_1^*) + \quad \beta\delta(1+r)^2 \mathbb{E}[u''(c_2^*)](\beta)}{u''(c_1^*) + \quad \beta\delta(1+r)^2 \mathbb{E}[u''(c_2^*)](\beta + (1-\beta)(1-\lambda))} \right). \end{aligned} \tag{A.15}$$

We see in (A.15) that compared to the results in Section (A.1.3), $\underline{\pi}_{\beta} < r = \underline{\pi}$. So, we have forced savings in the following limited sense. Holding constant the distribution of tax liability, wages, interest rate r and δ, withholdings are guaranteed to be zero for a larger range of penalties (i.e. $\pi \in [0, \underline{\pi})$) when the individual is time-consistent as compared to the time-inconsistent case (i.e. $\pi \in [0, \underline{\pi}_{\beta})$).

A.1.8 Discussion

To summarize, in a simple model of withholding with no uncertainty, tax filers are generally predicted to at most withhold exactly as much as their tax liability, i.e. there is no intentional overwithholding. This baseline model is unreasonable in at least two ways: it assumes that agents can very accurately predict their tax liability and it ignores adjustment costs. We see that if either of these assumptions is relaxed, then at least some share of agents may overwithhold.

Are these additional features enough to explain the data? In the case of uncertainty, we can conduct a back of the envelope calculation using the identity for the likelihood of overwithholding in (A.6). Rearranging (A.6) we have:

$$\frac{F(\hat{\tau}_U^*)}{1 - F(\hat{\tau}_U^*)} = \frac{\pi - r}{r} \cdot \frac{\mathbb{E}[u'(c_2^*) | \tau_0 > \hat{\tau}_U^*]}{\mathbb{E}[u'(c_2^*) | \tau_0 \leq \hat{\tau}_U^*]}. \tag{A.16}$$

Here we see the odds of overwithholding are proportional to the ratio of expected marginal utility in the event that one has either over- or underwithheld. We can plug in for $F(\hat{\tau}_U^*)$ the observed probability of overwithholding 0.8, a reasonable value for π of 0.03 and a risk-free rate of return of 0.02 for r. With these parameters the expected jump in marginal utility when underwithheld relative to when overwithholding is 8. This implies a significant drop in after-tax earnings. For example, with a CRRA utility function of form $u(c) = \frac{c^{1-\gamma}-1}{1-\gamma}$ and a coefficient of relative risk aversion $\gamma = 2$, it takes a 65 percent drop in consumption to generate an eight-fold increase in marginal utility. The model may also be salvaged by assuming a very high level of risk aversion or a significant upward bias in beliefs about π.

Nonetheless, it would appear that uncertainly alone cannot entirely explain the observed patterns of overwithholding.

One possible way to reconcile the data with the model is to introduce time-inconsistent preference, modeled by $\beta\delta$ preferences. We have shown that in certain cases, a time-inconsistent agent may choose a higher level of overwithholding than a time-consistent agent. However, in the baseline case with no uncertainty, the time-inconsistent agent is not distinguishable from a time-consistent agent based on the level of withholding. The $\beta\delta$ preferences must be combined with either a borrowing constraint or uncertainty to generate a forced savings result. In particular, we have shown in the case of certainty that the introduction of a borrowing constraint will weakly reduce withholdings for a time-consistent agent. In contrast, the effect of a borrowing constraint on a tax filer with $\beta\delta$ preferences is ambiguous, and may even result in higher withholdings. This provides a limited test of time-inconsistency. Unfortunately, in the IRS data used here, the presence of a borrowing constraint is unobserved, and therefore one is not able to perform such a test.

In the case of uncertainty, the $\beta\delta$ model does not go far in providing a better fit to the data. The analog to (A.16) in the time-inconsistent case is

$$\frac{F\left(\hat{\tau}^*_{\beta,U}\right)}{1-F\left(\hat{\tau}^*_{\beta,U}\right)} = \frac{\pi-\tilde{r}\left(\beta\right)}{\tilde{r}\left(\beta\right)} \cdot \frac{\mathbb{E}\left[u'\left(c_2^*\right)\middle|\, \tau_0 > \hat{\tau}^*_{\beta,U}\right]}{\mathbb{E}\left[u'\left(c_2^*\right)\middle|\, \tau_0 \leq \hat{\tau}^*_{\beta,U}\right]}, \tag{A.17}$$

where $\tilde{r}\left(\beta\right)$ is defined as before in (A.13). For a given probability of withholding, the model with time-inconsistent preferences will require a smaller drop in expected marginal utility if $\tilde{r}\left(\beta\right) < r$. Looking at (A.14), we can see that this will be true when:

$$\begin{aligned} \frac{\pi}{r}\lambda &< 1 \\ \text{or } \frac{F\left(\hat{\tau}^*_{\beta,U}\right)}{1-F\left(\hat{\tau}^*_{\beta,U}\right)} &< \frac{\pi-r}{r} \cdot \frac{\mathbb{E}\left[u''\left(c_2^*\right)\middle|\, \tau_0 > \hat{\tau}^*_{U}\right]}{\mathbb{E}\left[u''\left(c_2^*\right)\middle|\, \tau_0 \leq \hat{\tau}^*_{U}\right]}. \end{aligned}$$

Here again the model runs into problems fitting the data. Plugging in values from before, and assuming CRRA preferences again, we need at least a 50 percent drop in consumption when underwithheld relative to when overwithheld. This is still a rather large swing in consumption. As such, the $\beta\delta$ model cannot salvage an explanation of overwithholding based only on the model of uncertainty presented above.

An alternative explanation introduces adjustment costs associated with choosing a new level of withholding. Inertia alone does not predispose one toward overwithholding or underwithholding. However, if the payoff to correcting too low of a default withholding level is higher than the payoff to adjusting too high a default withholding level, i.e. $\pi - r > r$, then individuals will be more likely to exhibit inertia when overwithholding. Again, plugging in the values of $\pi = 0.03$ and $r = 0.02$ does not satisfy such a condition, though there may exist heterogeneity in both r and the perceived value of π among taxpayers. Alternatively, the model of inertia may generate a bias toward overwithholding if default withholding levels are more like to be higher than tax liability. This is true at least in the case where an individual does not file an initial W-4 form with the employer; the employer is instructed to choose zero allowances on behalf of the employee, with typically will result in overwithholding.

A.2 Estimating the Distribution of Allowances

The distribution of allowances $\hat{F}_0(A_0^i)$ and $\hat{F}_1(A_1^i)$ are estimated as follows. The data for tax filers from 1991 and 1992 are restricted to individuals who claimed a standard deduction, with wage and salary income comprising more than 95% of AGI and income below \$70,000 and \$110,000 for single and married filers respectively. This eliminates other sources of income that may confound the relationship between wages and withholdings and reduces the sample to those who were affected by the policy change. Next, for a given level of wages, a level of withholdings for each number of allowances was computed using IRS Publication 15, *Circular E: Employer's Tax Guide* for the given year. The number of allowances that generate the closest match to actual withholdings is assigned to the tax filer. Essentially, I invert the $P(\cdot)$ withholding functions. The discrete distribution of these estimated allowances are then calculated for each year-by-income group, separately for married and single tax filers, where the income groups are defined by AGI intervals of \$10,000. Under Assumption (4), I arrive at estimates of the conditional distributions, $\hat{F}_0\left(A_0^i|\,\theta^i\right)$ and $\hat{F}_1\left(A_1^i|\,\theta^i\right)$, where θ^i is a vector containing income group and marital status.

A.3 Calculating the Private Cost of Incorrect Withholding

A lower bound on the cost to the tax filer of overwithholding is measured as the money lost by giving the government an interest-free loan during the year. The relevant interest rate used in calculating the opportunity cost of overwithholdings depends on whether or not individuals are holding debt and the types of investment opportunities that are available to them. To calculate the "Interest Cost" of withholding I use the 2004 Survey of Consumer Finance (SCF) to impute interest rates for individuals in the 2004 IRS SOI data set.

For each observation in the SCF I record the maximum of (1) credit card interest rates for those with positive credit card debt, (2) the July 2004 rate of 1.06 percent for 9-month Certificates of Deposit (CD) for those with positive CD holdings or (3) a rate of 0.4 percent for those with a positive savings account balance. An interest rate of zero is recorded for individuals who hold none of the previous debts or assets. I then split the SCF into married and non-married households and further into income deciles, based on the IRS SOI income distribution. Next, for each observation in the IRS data set, I randomly draw an interest rate from their corresponding marital status by income decile pool in the SCF. The imputed interest rate is then multiplied by the individual's income tax refund or balance due. Those with a refund have a cost of overwithholding, while those with a balance due receive a benefit of underwithholding. The average costs in terms of loss or gained interest is reported for each income quintile and the total sample in Table 6.

If individuals face imperfect credit markets and/or have no savings, then an upper bound on the cost of overwithholding will be based on the inability to smooth consumption. To calculate these costs, I consider a case where individuals have a discount rate of zero and face an interest rate of zero. Income is received in T equal installments y. In this case, an individual with concave utility will desire a flat consumption profile. Now assume that tax prepayments are likewise paid in T equal installments, p and tax liability is also due in T equal installments l. Denote the monthly net refund as $r \equiv p - l$. If the individual overwithholds every period for T periods, she will receive a refund of $T \cdot r$ in month T (net withholdings of r are still incurred in month T). Finally, assume that individuals cannot borrow, so that consumption is equal to income minus net withholdings for overwithholders. The cost of overwithholding is the equivalent variation, $\triangle y$, of deviating from a constant consumption profile to one where the timing of income is distorted by overwithholding and satisfies the following:

$$\sum_{i=1}^{T} u\left(y - \triangle y\right) = \left[\sum_{i=1}^{T-1} u\left(y - r\right)\right] + u\left(y + \left(T-1\right) r\right). \tag{A.18}$$

For individuals who underwithhold $\triangle y$ is set to zero, as these tax filers can achieve the optimal, flat consumption profile by saving net withholdings until the last period and paying all taxes owed then. I assume a Constant Relative Risk Aversion (CRRA) functional form for utility: $u\left(c\right)=\frac{c^{1-\gamma}-1}{1-\gamma}$ or $u\left(c\right)=\ln(c)$ when $\gamma=1$. Solving for $\triangle y$ we have:

$$\triangle y=\begin{cases} y-\left[\frac{T-1}{T}\left(y-r\right)^{1-\gamma}+\frac{1}{T}\left(y+\left(T-1\right)r\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{when } \gamma\neq 1 \\ y-\exp\left[\frac{T-1}{T}\ln\left(y-r\right)+\frac{1}{T}\ln\left(y+\left(T-1\right)r\right)\right] & \text{when } \gamma=1. \end{cases} \tag{A.19}$$

The average, annual cost, $T\cdot\triangle y$, is calculated for each individual in the IRS SOI data set. Time periods are set to one month, $T=12$, y is one-twelfth of AGI and r is one-twelfth of the refund level. The average cost within each income quintile is reported in Table 6 for different values of γ.

A.4 Robustness Checks

Table A.1: Change in Child Dependents - Alternate Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Adjustment Rate: α_L						
	Baseline	Alternative Specifications					
Year 1	0.23	0.42	0.44	0.44	0.43	0.44	0.43
	(0.06)***	(0.07)***	(0.07)***	(0.08)***	(0.08)***	(0.07)***	(0.07)***
N	36,548	52,603	51,688	51,688	51,688	51,688	51,688
Year 2	0.33	0.53	0.55	0.57	0.59	0.54	0.57
	(0.06)***	(0.08)***	(0.08)***	(0.09)***	(0.09)***	(0.09)***	(0.09)***
N	25,650	46,011	45,143	45,143	45,143	45,143	45,143
Year 3	0.51	0.55	0.58	0.59	0.59	0.57	0.58
	(0.08)***	(0.09)***	(0.09)***	(0.10)***	(0.09)***	(0.09)***	(0.09)***
N	18,410	39,648	38,902	38,902	38,902	38,902	38,902
Time Trends		Yes	Yes	Yes	Yes	Yes	Yes
Drop 65+		No	Yes	Yes	Yes	Yes	Yes
Income Spline		No	No	Yes	Yes	No	Yes
Lagged Income Spline		No	No	No	Yes	No	Yes
Marriage Dynamics		No	No	No	No	Yes	Yes

Note: Estimates of the adjustment rate are obtained using Equations (11) - (13). Data are from a panel of US tax filers from the years 1979-1990. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table A.2: Change in Child Dependents - Alternate Samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Sample Used								
	Full	Stable	Balanced			Zero Balance I		Zero Balance II	
	Sample	Marriage	Sample	Losers	Gainers	Losers	Gainers	Losers	Gainers
Year 1	0.43	0.49	0.73	0.29	0.58	0.93	−0.03	0.80	0.05
	(0.07)***	(0.18)***	(0.34)**	(0.13)**	(0.14)***	(0.17)***	(0.07)	(0.15)***	(0.07)
N	51,688	12,487	4,222	24,084	25,686	9,074	12,424	13,080	16,501
Year 2	0.57	0.54	0.79	0.63	0.78	1.99	0.01	1.55	0.10
	(0.09)***	(0.18)***	(0.28)***	(0.17)***	(0.22)***	(0.41)***	(0.10)	(0.26)***	(0.12)
N	45,143	12,726	4,194	21,288	21,970	7,891	10,372	11,406	13,882
Year 3	0.58	0.51	0.47	0.73	1.05	1.89	0.13	1.64	0.16
	(0.09)***	(0.16)***	(0.38)	(0.28)***	(0.23)***	(0.42)***	(0.12)	(0.29)***	(0.11)
N	38,902	12,752	4,164	18,438	18,570	6,813	8,825	9,902	11,759

Note: Estimates of the adjustment rate are obtained using Equation (11). The "Stable Marriage" sample includes tax filers who do not experience a change in marital status during while in the panel. The "Balanced" sample only includes observations that are present for all seven years surrounding the event. The "Zero Balance I" sample is restricted to tax filers with a refund or balance due less than $1,000 in the base year, while the "Zero Balance II" sample uses a threshold of $1,500. Data are from a panel of US tax filers from the years 1979-1990.Controls include a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status, a dummy for transitions from single to married, individual and time fixed effects and a trend in event time. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table A.3: Change in Child Dependents - Alternate Sample Descriptive Statistics

	(1)	(9)	(8)	(2)	(3)	(4)	(5)	(6)	(7)
	Sample Used								
	Full	Stable	Balanced			Zero Balance I		Zero Balance II	
	Sample	Marriage	Sample	Losers	Gainers	Losers	Gainers	Losers	Gainers
Adjusted Gross Income									
10th Percentile	9,581	14,193	14,060	11,166	8,399	8,187	5,515	8,930	6,312
Median	37,205	45,108	43,125	42,531	32,303	35,292	24,441	35,132	25,783
90th Percentile	84,295	89,841	85,669	90,688	76,535	77,234	61,947	76,935	63,544
Mean	43,793	49,941	47,822	48,354	39,330	40,313	30,292	40,263	31,737
Standard Deviation	35,597	35,919	31,793	37,538	32,585	31,704	25,170	30,608	25,652
Refund									
Mean	932	1,019	1,035	762	1,099	285	666	426	771
Median	905	966	908	801	991	357	605	499	737
Prepayment to Liability Ratio									
10th Percentile	0.79	0.81	0.85	0.73	0.86	0.77	0.89	0.79	0.90
Median	1.23	1.22	1.22	1.17	1.31	1.08	1.23	1.11	1.26
90th Percentile	2.38	2.16	2.08	2.13	2.62	1.73	2.57	1.87	2.62
Refund to AGI Ratio									
Mean	0.04	0.03	0.03	0.03	0.04	0.02	0.04	0.03	0.04
Median	0.03	0.03	0.03	0.02	0.04	0.01	0.03	0.02	0.03
Refund Probability	0.80	0.79	0.79	0.75	0.85	0.69	0.84	0.73	0.85
Share of Total Filers	0.23	0.08	0.03	0.12	0.12	0.04	0.06	0.06	0.08
N	62,604	16,048	5,476	30,517	32,087	11,554	15,585	16,617	20,598

Note: See Table A.2 for descriptions of samples. Dollar amounts are reported in year 2000 levels.

Table A.4: Change in Child Dependents - Heterogeneity in 1-Year Adjustment Rate Estimates

	(1)	(2)	(3)	(4)	(5)
	Separate Estimates:				Joint Estimates:
α_L	0.43	0.41	0.40	0.23	0.36
	(0.08)***	(0.08)***	(0.09)***	(0.27)	(0.13)***
α_L x # Changes	-	0.00	-	-	-0.02
		(0.01)			(0.01)
α_L x Married	-	-	0.05	-	0.08
			(0.10)		(0.16)
α_L x AGI	-	-	-	0.14	0.07
(unit = \$40,000)				(0.08)*	(0.06)
$\bar{\alpha}_L$	0.43	0.41	0.43	0.38	0.47
	(0.08)***	(0.07)***	(0.07)***	(0.21)*	(0.11)***
N	51,688	51,688	51,688	51,688	51,688

Note: Estimates of mechanical effect, behavioral response and adjustment rate are obtained using Equations (11)-(15), where $j = 1$. Data are from a panel of US tax filers from the years 1979-1990. Controls include a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status, a dummy for transitions from single to married, individual and time fixed effects and a trend in event time. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table A.5: Change in Child Dependents - Heterogeneity in 2-Year Adjustment Rate Estimates

	(1)	(2)	(3)	(4)	(5)
	Separate Estimates:				Joint Estimates:
α_L	0.57	0.57	0.59	0.36	0.50
	(0.09)***	(0.09)***	(0.10)***	(0.27)	(0.19)***
α_L x # Changes	-	-0.01	-	-	-0.01
		(0.01)			(0.01)
α_L x Married	-	-	0.01	-	-0.08
			(0.11)		(0.15)
α_L x AGI	-	-	-	0.09	0.07
(unit = $40,000)				(0.07)	(0.06)
$\bar{\alpha}_L$	0.57	0.56	0.60	0.46	0.51
	(0.09)***	(0.09)***	(0.09)***	(0.22)**	(0.18)***
N	45,143	45,143	45,143	45,143	45,143

Note: Estimates of mechanical effect, behavioral response and adjustment rate are obtained using Equations (11)-(15), where $j = 2$. Data are from a panel of US tax filers from the years 1979-1990. Controls include a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status, a dummy for transitions from single to married, individual and time fixed effects and a trend in event time. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.

Table A.6: Change in Child Dependents - Heterogeneity in 3-Year Adjustment Rate Estimates

	(1)	(2)	(3)	(4)	(5)
	Separate Estimates:				Joint Estimates:
α_L	0.58 (0.09)***	0.60 (0.10)***	0.53 (0.10)***	0.56 (0.20)***	0.52 (0.14)***
α_L x # Changes	-	-0.01 (0.01)	-	-	-0.01 (0.01)
α_L x Married	-	-	0.18 (0.10)*	-	0.17 (0.12)
α_L x AGI (unit = \$40,000)	-	-	-	0.00 (0.04)	-0.03 (0.04)
$\bar{\alpha}_L$	0.58 (0.09)***	0.59 (0.09)***	0.65 (0.08)***	0.56 (0.16)***	0.59 (0.13)***
N	38,902	38,902	38,902	38,902	38,902

Note: Estimates of mechanical effect, behavioral response and adjustment rate are obtained using Equations (11)-(15), where $j = 3$. Data are from a panel of US tax filers from the years 1979-1990. Controls include a 10-piece linear spline in income by marital status, a similar spline in lagged income, martial status, lagged martial status, a dummy for transitions from single to married, individual and time fixed effects and a trend in event time. Robust standard errors are reported in parentheses. One, two and three stars denote statistical significance at the 10%, 5% and 1% level respectively. Dollar amounts are reported in year 2000 levels.