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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 four different settings for identification: (1) a 1992 change in default federal withholding, (2) a panel study of child dependents and tax liability, (3) the expansion of the Earned Income Tax Credit (EITC) during the 1990s and (4) a change in default enrollment rules for the Advance EITC option. In the first two cases, I find that individuals offset less than 30% of a change to their expected refund after one year, and about 50% of this shock after three years. Adjustments in tax prepayments by EITC recipients offset no more than 2% of a change in tax liability, though evidence from the Advance EITC indicates that information can significantly increase responses. 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.

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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 roughly 30 percent of the change in their refund level after one year. In addition, I argue that this response may be related to the salience of the external shock.

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. Comparing outcomes before and after the policy across "treated" and "untreated" groups, I find that within the first year of this new policy, tax filers offset about 30 percent of the mandated change in withholdings. In the three years following this policy change, withholding changes by tax filers offset between 17 and 28 percent of the initial shock to the refund level.[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 23 percent of the change in tax liability in the first year. Three years following the shock, prepayments have adjusted to account for 51 percent of the change in tax liability. I additionally find evidence of an asymmetric response and salience of a zero tax balance. In particular, when the loss of a child dependent causes a tax filer to transition from receiving a refund in the baseline year to owing a balance due in the following year, the corresponding adjustment in prepayments is much larger, between 56 and 78 percent. This response is much more pronounced than in the opposite case when a balance due becomes a tax refund or in general for tax liability changes in either direction that are not large enough to be the difference between a refund or balance due.

Next, 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]. Overpayments for this group are on average 13 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 during the 1990s. 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

[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.

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.

Finally, I complement this evidence of inertia among EITC recipients with administrative panel data on Advance EITC participation within a large firm. The Advance EITC is an option that allows EITC eligible workers to receive a portion of their EITC in every paycheck, as opposed to receiving the entire credit as a "lump sum" at in the end of the tax year. Thus, the decision to make use of this option is equivalent to lowering tax prepayments. I observe data from a firm that introduces a new policy requiring employees to renew Advance EITC payments annually. Consistent with the preceding results, I find that this shift in default enrollment has significant effects on Advance EITC participation. Ending a policy of automatic renewal reduces take-up to about 65 percent of its original level. The effect of this shock on tax prepayments is much smaller than in the previous three cases. This is in part due to efforts by the employer to limit the effects of the default change. An employer intervention, in the form of targeted notices highlighting the new rules, was implemented prior to the first renewal date and again following the second one. In comparing the two cases, it appears that (1) in the absence of the informational intervention, the default effects would have been much more pronounced and (2) these informational efforts taken by the employer help to offset a majority of the default effects.

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

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

tax prepayments and result in costly constraints on liquidity throughout the year. Third, the data is generally consistent with the idea that the salience of a change in tax liability or default withholdings is related to the level of inertia. This is most cleanly shown with the effect of information on Advance EITC enrollment.[3]

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. 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 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

[3] Jones [Forthcoming] shows that information does not increase Advance EITC participation for previously unenrolled workers. However, I show here that information does mitigate the effect of default changes on workers who are already enrolled in the Advance EITC program.

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. Withholdings are then computed by the employer using the employee's W-4 form, the employee's level of earnings and an IRS-provided withholding schedule. 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. There are two endogenous determinants of prepayments and liabilities, A and E. 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:

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

where the first two terms on the right-hand side constitute a behavioral response by the tax payer 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:*

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

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 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

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

[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.

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 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 four 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 two cases, the 1992 change in default withholdings and the Advance EITC case study, there is a change in default withholdings while holding liability constant. In the other two cases, the panel study of child dependents and the 1990s 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. I also highlight two other significant differences across the four events: the relative salience of each shock and 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 primary 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. For the additional analysis of the Advance EITC, I use administrative panel data collected by Jones [Forthcoming]. Within a firm of about 80,000 employees, I observe all employees who receive Advance EITC payments from February 2006 until September 2008. Enrollment peaks at about 400. The data include the weekly Advance payment amount and other information about the retail location in which the employee works.

4.2 Descriptive Statistics

I provide summary statistics on overwithholding for tax filers in 2004 in Column (4) of Table 1. On average, individuals receive a refund of $1,000 and make prepayments that are 3 times as large as their tax liability. These 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. The former is estimated using wage and withholding data to impute the number of allowances taken 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 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

[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.

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, 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. 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.

In terms of salience, tax payers 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]. 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.

Panel B of Figure 2 plots refund levels for married tax filers from 1980 to 2000. The sample is restricted to tax filers with AGI below $110,000 (in year 2000 dollars), which is roughly the maximum income for which default withholdings changed in 1992. The sample is further split by composition of income. The first group, "wage earners," has wage and salary income above $7,364 and thus is subject to the withholding change. The second group, "non-wage earners," has wage and salary income below this threshold and is therefore not

[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.

subject to the change in default withholdings. Non-wage earners may have other sources of income, such as self-employment, interest or dividend income. I refer to the two groups as the "treatment" and "control." The vertical lines in the Figure denote the period over which default withholdings were reduced. We see a noticeable decline in refunds for wage earners during the policy change. The same is not true for non-wage earners. This visual evidence is merely suggestive, however, as the difference in composition of income may be correlated with significant, unobservable differences between the two groups.

5.1.1 Difference-in-Difference Estimates

As an initial step toward estimating an adjustment rate, I compare withholdings before and after the policy and also between the "treatment" and "control" tax filers using a difference-in-difference (DD) estimator. First, data are grouped into cells based on year and marital status. The cells are further divided into two groups based on wage and salary income. One group has enough wage and salary income to be affected by the change in withholding tables, while the other does not. These cutoffs are \$3,007 and \$7,364 for single and married filers respectively. Those with wages below the cutoffs may have other sources of income, such as self-employment income or investment income. The data are then split by adjusted gross income (AGI) into intervals of \$10,000. Finally, cells of single and married filers with AGI above \$70,000 and \$110,000 respectively were dropped, as tax filers in these groups were generally not subject to the change in withholdings. This procedure resulted in 36 cells per year. All variables were then averaged at the cell level using sample weights.

The net effect of the policy change on prepayments is $\triangle\mathbf{P} = (\triangle P_M + \triangle P_B)$. That is, the total change in prepayments is the sum of the mechanical and behavioral components. I can estimate this net effect using cell averages in the following regression:

$$\bar{P}_{gt} = \eta_g + \eta_t + \triangle\mathbf{P} \cdot T_{gt} + \Gamma\bar{\mathbf{X}}_{gt} + \varepsilon_{gt}, \tag{8}$$

where $\bar{P}_{gt}$ denotes average tax prepayments in the form of either withholdings or estimated payments, η_g and η_t are cell and year fixed effects and $\bar{\mathbf{X}}_{gt}$ is a vector of average tax liability and EITC credits. The variable T_{gt} is a treatment indicator that equals 1 if both the cell year is after the policy change and the cell wages are within the eligible range to be affected by the executive order. This regression is run for groups of two years, comparing 1991 outcomes to those in each of the years 1992, 1993, and 1994. I similarly estimate so called "placebo" regressions: the change in withholdings between 1990 and 1991 and the change in estimated payments between 1991 and 1992, both quantities unlikely to be affected by the change in tax policy. Robust standard errors and standard errors clustered at the cell level are calculated. This method does not allow me to separately identify the mechanical and behavioral effects. However, I can approximate α_P using the following identity:

$$\alpha_P = \frac{\triangle P_M - \triangle \mathbf{P}}{\triangle P_M} \tag{9}$$

As stipulated in the executive order, I can substitute a mechanical effect, $\triangle P_M$, of \$187 and \$423 for single and married tax filers respectively. This will tend to underestimate the adjustment rate, since I am substituting the maximum mechanical effect rather than the actual effect for those in the phase-in and phase-out of the withholdings change.

Column (1) of Table 2 reports the estimates for the full sample, and separately for single and married filers. The average decrease in withholdings, $\triangle \mathbf{P}$, is \$255. The net effects for single and married filers are on the same order of policy change, \$157 and \$369 respectively. Using the identity in (9), this implies an α_P of 0.16 and 0.13 respectively. In Columns (2) and (3), I conduct the DD estimate between 1991 and each of the years 1993 and 1994. We see that the effect is still significant three years out, with an implied α_P of 0.17 and 0.28 for single and married filers respectively. I also conduct two "placebo" experiments in Columns (4) and (5) of Table 2. Column (4) indicates that there are not comparable changes in withholdings between 1990 and 1991. Also, there were no significant changes in estimated payments between 1991 and 1992, which are not effected by the executive order. Thus, it appears that the drop in withholdings is due to the change in defaults in 1992.

5.1.2 Incorporating Information from Withholding Tables

I can go a step further by using information on the relationship between withholdings, wages and allowances to arrive at an alternative measure of α_P. This alternative method of estimating the mechanical effects, behavioral responses and adjustment rates requires the following three components:

$P_0\left(A_0^i, E^i\right)$: baseline withholdings prior to the policy change
$P_1\left(A_0^i, E^i\right)$: withholdings following the policy change, holding allowances fixed
$P_1\left(A_1^i, E^i\right)$: withholdings after the policy change and change in allowances.

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:*

$$F_0(A_0)|_{t=91} = F_0(A_0)|_{t=92}$$

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, $\hat{F}_0(A_0|\boldsymbol{\theta})$ and $\hat{F}_1(A_1|\boldsymbol{\theta})$, where $\boldsymbol{\theta}$ is a vector containing income group and marital status.[8] Using these conditional distributions, I estimate withholdings as follows:

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

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

$$\triangle P_M^i = \hat{P}_1^i\left(A_0^i, E^i\right) - \hat{P}_0^i\left(A_0^i, E^i\right) \tag{10}$$

$$\triangle P_B^i = \hat{P}_1^i\left(A_1^i, E^i\right) - \hat{P}_1^i\left(A_0^i, E^i\right). \tag{11}$$

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

$$\triangle P_B^i = -\alpha_P \cdot \triangle P_M^i + x^i\beta + \varepsilon^i, \tag{12}$$

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.

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

Panel C 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 is evidence of a behavioral response.

In Table 3, I estimate the fraction by which this behavioral response offsets the mechanical effect of the policy shock. The sample is again restricted to individuals within the range of affected wages. Using Equation (10), I estimate an average mechanical decrease in withholdings of $237, with conditional averages of $180 and $392 for single and married filers respectively. In contrast, I estimate an average behavioral response of only $60 in additional withholdings using Equation (11). Estimating Equation (12), this translates into an estimate of 0.30 for α_P. Tax filers only offset 30 percent of the decrease in withholdings during the first year of the policy change. This estimate is slightly larger than the DD estimate. Whereas the approximation using simple DD estimate assumes that every tax payer received the maximum reduction in withholdings, the current estimate reflects the fact that some taxpayers received a smaller reduction in withholdings.

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 number of children 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 prepayments and refund probabilities.

In Column (2) of Table 1, we see that, compared to the other cases that I consider, this sample is the most representative of entire tax filing population. The data are essentially trimmed of the top 1 percent of incomes, for whom information on children is obscured for confidentiality purposes. 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. In the analysis that follows I include income and marital status as control variables.

5.2.1 Pooled Estimates

I will first estimate the adjustment rate assuming that the response is the same whether a tax filer loses or gains a dependent. I estimate the following structural equation using two stage least squares (2SLS):

$$prepayment_{it} = \eta_i + \eta_t + \alpha_L \cdot liability_{it} + \Gamma \mathbf{X}_{it} + \varepsilon_{it}. \quad (13)$$

The first stage and reduced form regressions are as follows:

$$liability_{it} = \tilde{\eta}_i + \tilde{\eta}_t + \sum_{k=-10}^{10} \triangle L_l^k \cdot Loss_{i,t-k} - \sum_{k=-10}^{10} \triangle L_g^k \cdot Gain_{i,t-k} + \tilde{\Gamma} \mathbf{X}_{it} + \tilde{\varepsilon}_{it} \quad (14)$$

$$prepayment_{it} = \acute{\eta}_i + \acute{\eta}_t + \sum_{k=-10}^{10} \triangle P_l^k \cdot Loss_{i,t-k} - \sum_{k=-10}^{10} \triangle P_g^k \cdot Gain_{i,t-k} + \acute{\Gamma} \mathbf{X}_{it} + \acute{\varepsilon}_{it} \quad (15)$$

where η_i and η_t are individual and time fixed effects. The vector $\mathbf{X}_{it}$ includes a cubic in AGI, marital status and an indicator for age above 65 years. The $Loss_{i,t-k}$ and $Gain_{i,t-k}$ are a set of dummy variables indicating that at time t a change in dependents has taken place k periods in the past, or in the future for $k < 0$. The coefficients $\triangle L_l^k$ and $\triangle L_g^k$ in equations equation (14) can be thought of as the mechanical effect on current tax liability of a change in child dependents k periods ago for losers and gainers respectively. The coefficients $\triangle P_l^k$ and $\triangle P_g^k$ in (15) can likewise be thought of as the behavioral response by tax payers. I summarize these changes using the following weighted averages:

$$\triangle L_M^k = \pi_l \cdot \triangle L_l^k + \pi_g \cdot \triangle L_g^k \quad (16)$$

$$\triangle P_B^k = \pi_l \cdot \triangle P_l^k + \pi_g \cdot \triangle P_g^k, \quad (17)$$

where π_l and π_g are the share of losers and gainers in the sample. The $\triangle L_M^k$ and $\triangle P_B^k$ are measures of the average mechanical effect and behavioral response. Finally, the parameter α_L measures the response of tax prepayments to changes in tax liability. The 2SLS method allows me to isolate the variation in liability generated by the loss or gain of a child dependent.

In Figure 3, I plot the coefficients from Equation (14).The horizontal axis measures time and the vertical axis measures outcomes relative to the year in which the number of child dependents changes. Though liability is generally declining as the event nears, there is a sharp increase in tax liability when a dependent is lost. The inverse is true for gains in dependents. We also observe that the estimates become increasingly noisy as time passes. Therefore, I focus on windows of three years after the event when reporting point estimates. Figure 3 also plots the associated dynamics of tax prepayments, estimated using Equation (15). Here we see prepayments do not change as sharply following the baseline year.

In Table 4, 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 $590 dollars. This change in tax liability persists over the next three years. In Column (2) of Table 4, we see that the response of tax prepayments is not as large: $138 following a change in the number of dependents. This response gradually increases over time. Finally, the adjustment rate estimated from Equation (13), α_L, is reported in Column (3). In the first year following the change in tax liability the adjustment rate is about 0.23. Tax prepayments do not fully adjust; three years after the change in dependents, only 51 percent of the shock has been undone.

5.2.2 Losers versus Gainers and the "Zero Balance" Effect

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 those 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 5 presents adjustment rates separately for losers and gainers in Columns (1) and (2). The two groups have very 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 in the first year. Thus, evidence of an asymmetric response does not show up for the general sample.

An alternative theory is that tax filers generally exhibit the same response to increases and decreases in tax liability, but changes near a zero balance are more salient and trigger a greater reaction. Given that most tax filers initially have excess withholding, we may not pick up the salience of a zero balance in the general population. Thus, in Columns (3) and (4), I restrict the sample to tax filers that have an initial refund level or balance due less than $1,000. For this sample, a loss of a child dependent 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 0.56 and 0.78 in the first three years following a change in dependents, while gainers' adjustment rates are much closer to zero, and possibly even negative. The results suggest that transitioning from receiving a refund to owing a balance is particularly salient to tax filers and prompts a larger response. Such variation in inertia is consistent with the observed prevalence of income tax refunds. However, I cannot completely rule out the presence of unobserved differences between losers and gainers and between the full sample and "zero balance" sample that drive these results.

5.3 1990s EITC Expansion

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 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. I discuss this option in the next section.

In terms of salience, 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 making the schedule more salient 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 the 1990s. First, I exclude tax filers with zero prepayments, who have no means of further lowering prepayments. I group observations annually into four categories. The first group is ineligible for the EITC. The next three groups are EITC-eligible tax filers with zero, one 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.[9] Next, I calculate group-by-year averages and estimate the following linear model:

$$\overline{P}_{gt} = \eta_g + \eta_t - \alpha_L \cdot \overline{EITC}_{gt} + \Gamma \cdot \overline{X}_{gt} + \varepsilon_{gt}, \tag{18}$$

where g indexes the four groups, t is a year index, the η's are group and year fixed effects

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

and $\bar{X}_{gt}$ is a vector of average observable controls including a cubic in income, tax liability, 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 (3) of Table 1, this sample represents about 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. It is surprising, then, that these tax filers are particularly prone to overwithholding. We see in Table 1 that they make tax prepayments that are on average more than 8 times as much as they owe. 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 sharp declines in prepayments, which, as has been shown, is due to a 1992 Executive Order. Finally, 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 6 reports the coefficients estimated from Equation (18). 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.[10] Controlling for group or time fixed effects does little to change this result. 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.

[10]Without any controls, those who received the EITC have lower average prepayments. This is a spurious relationship reflecting the fact that EITC-eligible tax filers have much lower incomes, and thus mechanically withhold less than non-eligible tax filers.

5.4 Change in Enrollment Defaults for the Advance EITC

I extend the analysis of inertia among EITC recipients with a case study of the Advance EITC. The Advance EITC is an option that allows EITC eligible workers to receive a portion of their refundable credit earlier in each paycheck, as opposed to a one time payment at the end of the tax year. In effect, this option gives tax filers another method by which withholdings may be reduced and even allows for withholdings to be reduced below zero. The program requires employees to fill out a W-5 form indicating that they expect to receive the EITC. Though this option has been available since 1979, participation in the program is very low. It is estimated that between 0.5 and 3 percent of eligible workers make use of the Advance EITC [Jones, Forthcoming]. One distinctive feature of this program is that individuals must renew Advance EITC payments every year. Here, the policy variable, Z, is Advance EITC participation, which automatically ends at the renewal date if no action is taken. In this case, tax prepayments are affected, but tax liability does not change for tax filers: $\partial L/\partial Z = 0$ and we are estimating α_p. The primary method by which individuals offset the policy, A, is to re-enroll in the Advance option. Alternatively, individuals may lower withholdings through allowances or lower estimated payments.

I will present evidence from data collected by Jones [Forthcoming] in the context of a field experiment. The data track Advance EITC enrollment within a large firm that introduces the annual renewal requirement to employees. This feature, mandated by law, requires the Advance recipient to renew payments at the beginning of every calendar year. The participating firm had previously followed a policy of automatic renewal, but then switched to an active renewal requirement in order to comply with IRS tax code. The data cover the first two renewal dates introduced by the firm. Prior to the first date, all Advance EITC recipients within the firm were made aware of the upcoming change. The same was not done at the second date. However, following the second deadline, efforts were taken by the firm to re-enroll individuals who had been removed. This informational intervention separates tax filers in this sample from the previous three cases, in that the salience of the change in default withholdings is far greater. The mechanical effect of the policy is a reduction in Advance payments to zero and the behavioral response is measured by the re-enrollment of employees into the Advance program. Comparing Advance payments before and after the deadlines will yield an estimate of the adjustment rate, α_p.

Figure 5 displays the effects of the deadline on participation, as well as the countervailing effect of the company's notification efforts. The vertical lines denote the first and second renewal dates. Because the company only realized its need to comply well into the year

2007, the first renewal requirement is not introduced on the typical date of January 1st. Subsequent renewal dates are enforced annually at the beginning of January. This allows the default effect to be identified separately from any general end of the year effects on enrollment.

As can be seen in Figure 5, the introduction of a renewal requirement reduces Advance EITC enrollment by more than 25 percent at the first renewal date. The drop in enrollment at the first date is not as steep as that of the second renewal date, which implies that the informational notice helped mitigate the effect of the renewal requirement. At the second renewal date, when no prior notice is provided, enrollment temporary reaches zero and then begins to sharply rebound, following efforts by the firm to re-enroll employees. Although in both cases enrollment recovers significantly, the change in defaults appears to have permanently reduced long-run enrollment.

Table 7 reports the adjustment rate, α_P, associated with the change in enrollment at the deadline. As can be seen both graphically and from the Table, the employees are much more effective in offsetting the shock to withholdings than in the three previous settings. Just months after each renewal requirement, the rebound in enrollment implies an α_P of 0.82 and 0.75 respectively for the first and second dates. This is true whether one considers enrollment or weekly Advance EITC payments as the margin of adjustment.

6 Discussion and Conclusion

For the majority of cases, I observe estimates of an adjustment rate in the first year that range from nearly 0 in the case of the EITC to about 0.30 following a change in default withholdings. The effect of these shocks on the refund level appears to persist for some time. In the case of the 1992 change in default withholdings, the effect of new withholdings tables appear to remain even after three years. The ratio of the net drop in withholdings and the initial decrease intended by the policy change imply an adjustment rate between 0.27 and 0.38 after three years. Further evidence is drawn from the panel study of child dependents and tax liability. In Table 4 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 are some exceptional cases that are worth noting. Though EITC recipients generally exhibit the greatest amount of inertia, I find very different results in a case study involving the Advance EITC. Tax filers exhibit a much greater response after default rules dictating Advance enrollment are changed, offsetting more than 75 percent of the default effect. In that instance, the employer took significant effort to preempt the default effects. Relative to the other examples I consider, these tax filers receive direct information signaling the change that has taken place.

Another outlying case is found when considering child dependents and tax liability. When a change in child dependents causes a switch from a refund to balance due, the adjustment rate after one year increases from 0.11 to 0.56 for tax filers. The same is not true for tax filers who experience a change from owing a balance due to receiving a refund, or in general for tax filers who experience a change in number of dependents but no change in refund status. Thus, individuals appear to be fairly indifferent to nudges in their refund level, even particularly large ones, such as the growth in EITC levels, regardless of the direction of the drift. However, if the nudge causes them to transition from receiving a refund to owing a balance, action is more likely to be taken to undo the shock to the refund level.

In both cases, the salience of the change in tax liability or default withholdings may be triggering a greater response. This is most notable in the case of the Advance EITC. In Figure 5 we see a marked difference in the reduction in enrollment between the first and second renewal dates. The key difference between the two dates is the timing of information regarding the policy change. A similar story may underlie the heightened response to a change in child dependents when one has a near zero tax balance. Individuals (or their accountants) may follow a simple rule of thumb of never owing a balance to the IRS. Or, a newly acquired balance due may be associated with a penalty and/or an increase in the perceived risk of being audited. Alternatively, individuals may bank on receiving some "windfall" of cash in the form of an income tax refund and subsequently find having to write a check to the IRS particularly discouraging. In any of these cases, a zero balance may emerge as a focal point. These theories are only speculative, as the data used here are limited in their ability to sort out these stories.

Another pattern that emerges is that inertia is greatest among the lower-income population, those receiving the EITC. This is made clear in Table 6, Column (4) where I rule out an adjustment rate greater than 0.02. This is reinforced in the case of Advance EITC. Though tax filers were very responsive to changes in the Advance EITC, Figure 5 suggests that in the absence of an employer intervention, the default effect would have been much larger. 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.

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 tax payers 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 tax payers will not readjust their withholdings. In each of these cases, the affect of withholding policies on tax payers 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 tax payers in 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 8 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 8. 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.[11]

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

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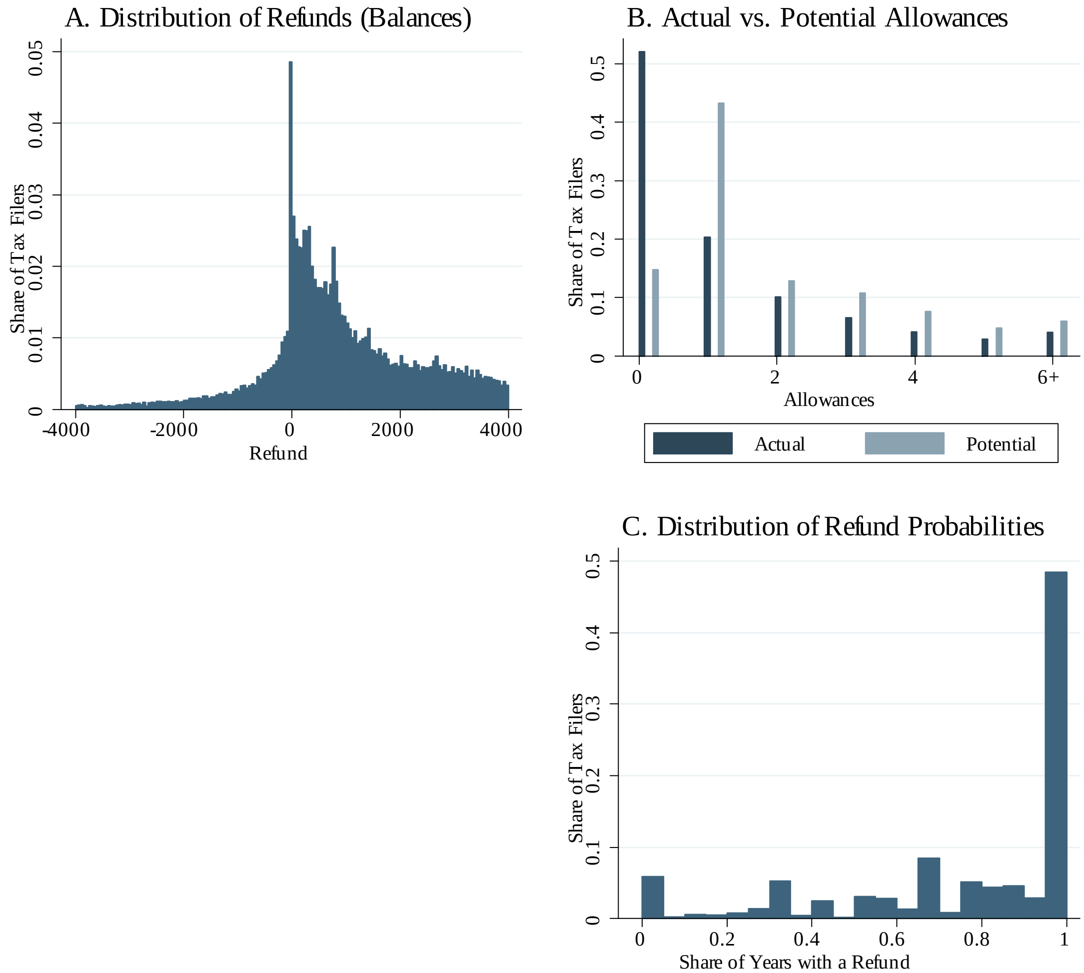
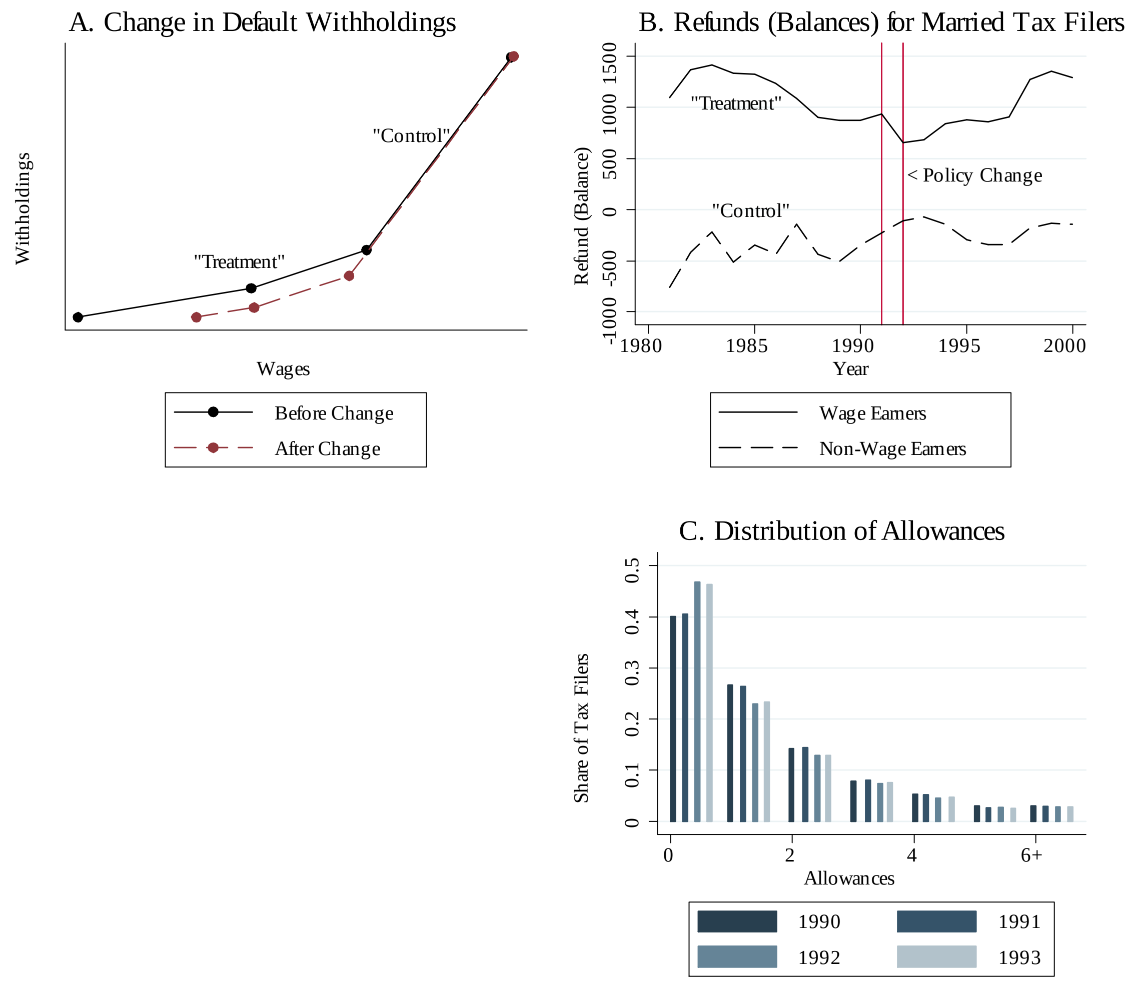
Figure 1: Descriptive Statistics



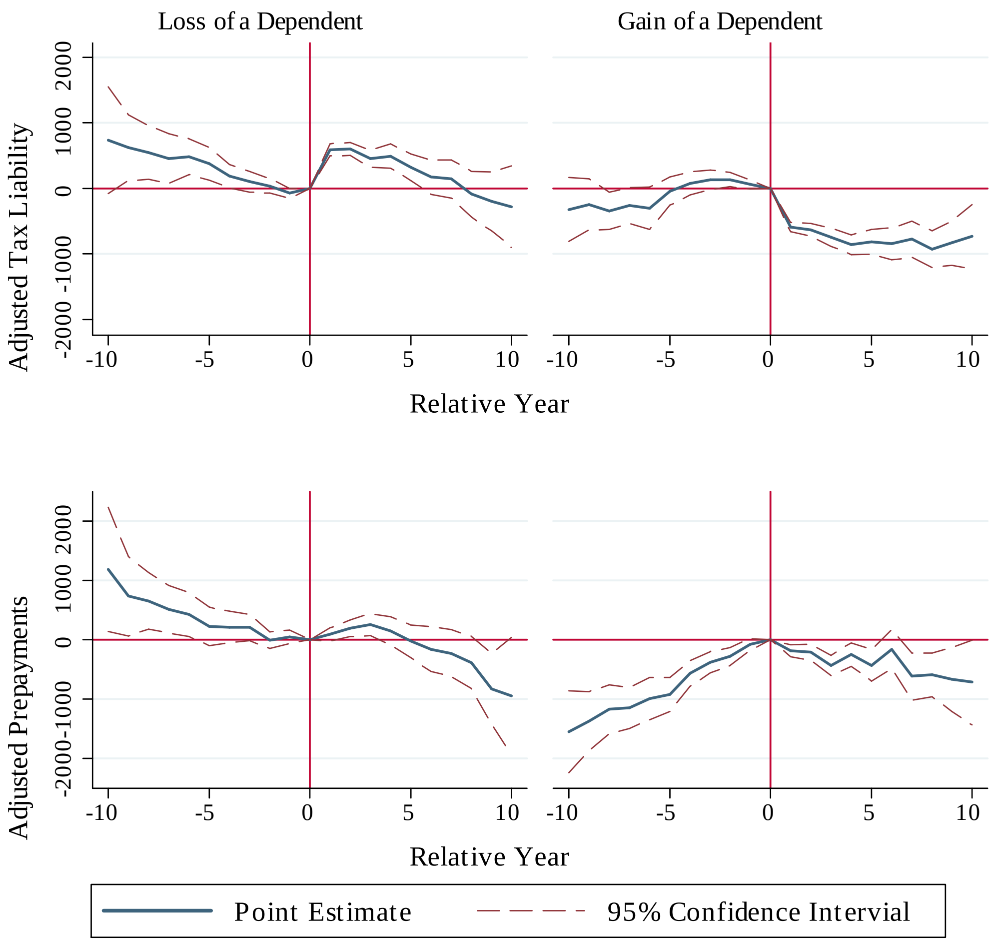
Note: (A) The distribution of refunds and balances are for US tax filers in 2004, taken from the IRS SOI public use file. (B) Actual number of allowances is estimated using the amount of withholdings reported on the tax return in conjunction with wages, marital status, AGI and IRS withholding tables. See the appendix 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 only wages as a source of income, 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



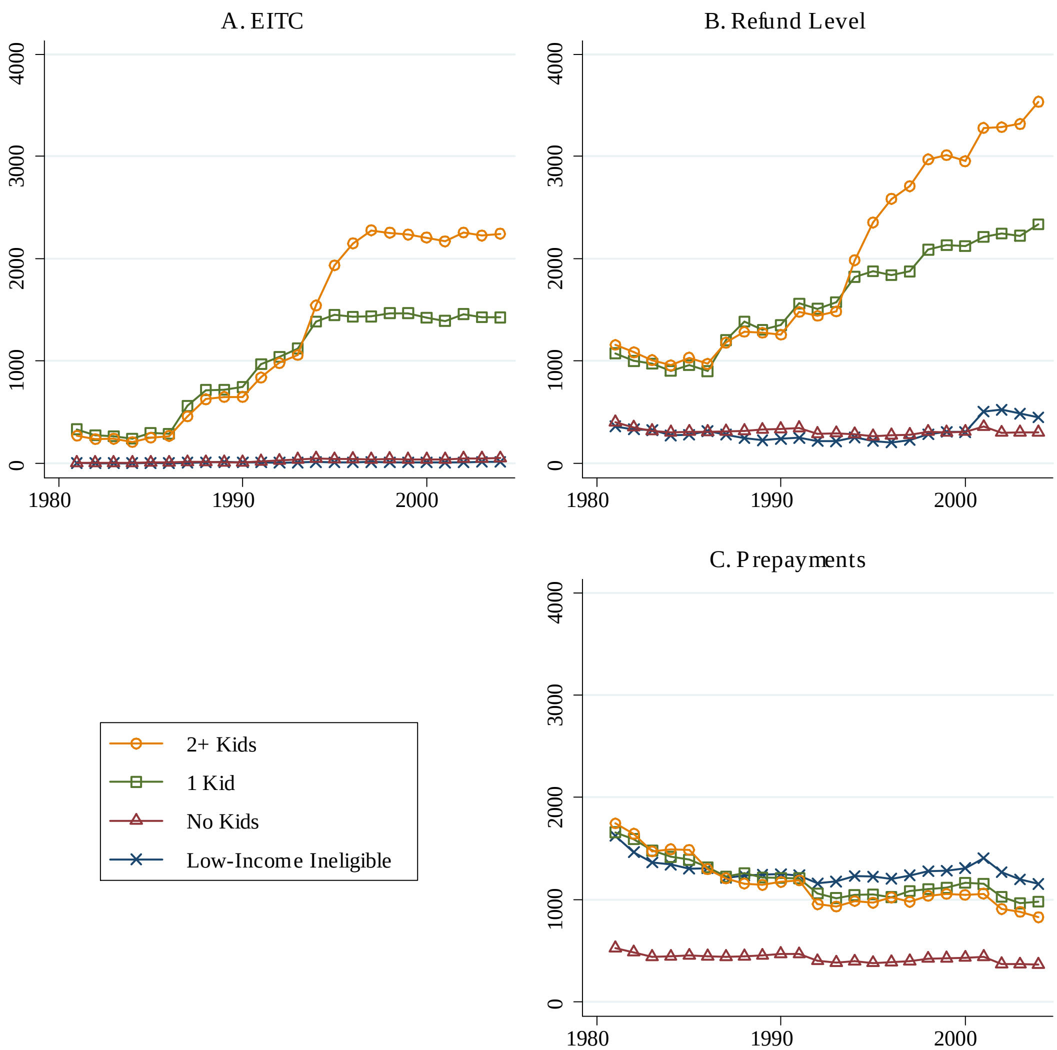
Note: (A) Graphical demonstration of the adjustments made to withholdings tables following the 1992 Executive Order. (Not Drawn to Scale). (B) Refund levels are for married tax filers with AGI below \$110K. Those in the first group, "wage earners," have wage income above \$7,364 and thus are subject to the 1992 change in defaults. Those in the second group, "non-wage earners," have wage income below this threshold and thus were not subject to the change in defaults. The vertical lines denote the period over which default withholdings were changed. (C) 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% 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



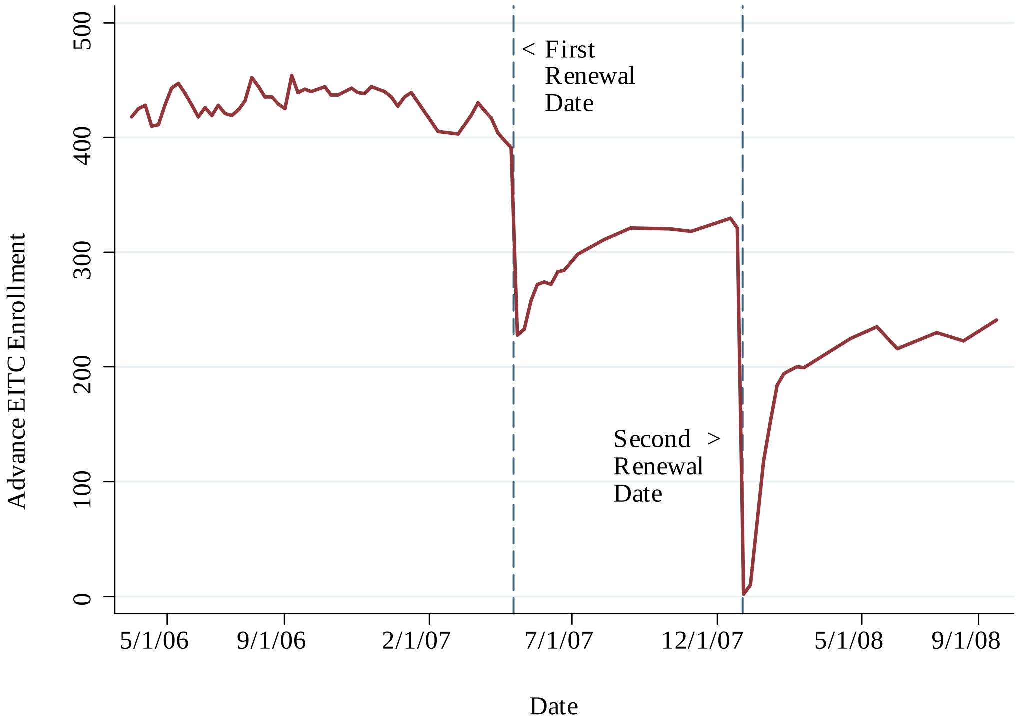
Note: The expected change in tax liability and prepayments at the time of a change in dependents is estimated using a panel of US tax filers spanning 1979 to 1990. Coefficients are obtained in an event study regression, as specified in Equations (14) and (15).

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% 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.).

Figure 5: Effect of Renewal Requirement on Advance EITC Enrollment



Note: Companywide enrollment in the Advance EITC program from February 2006 to June 2008. Vertical lines indicate renewal dates beyond which enrollment is ended by default unless an employee actively re-enrolls.

Table 1: Descriptive Statistics

	(1)	(2)	(3)	(4)
	Sample Used In Analysis			
	1992 Change in Default Withholdings	Panel Study of Child Dependents	1990s EITC Expansion	Tax Year 2004
Adjusted Gross Income				
10th Percentile	3,188	4,624	2,094	4,516
Median	17,928	26,256	8,497	27,047
90th Percentile	46,154	75,240	23,695	89,965
Mean	21,789	35,246	10,811	46,745
Standard Deviation	17,295	35,049	20,959	329,022
Refund				
Mean	769	601	1,358	1,070
Median	546	511	719	747
Prepayment to Liability Ratio				
Mean	3.39	2.39	8.65	3.00
Median	1.29	1.20	2.44	1.26
Refund to AGI Ratio				
Mean	0.06	0.03	0.13	0.07
Median	0.04	0.03	0.09	0.03
Refund Probability	0.88	0.75	0.96	0.79
Time Period	1991-1992	1979-1990	1990-2004	2004
Share of Total Filers	0.45	0.99	0.25	1.00
N	61,378	293,011	153,178	150,047

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 - Difference-in-Difference Estimates

	(1)	(2)	(3)	(4)	(5)
	Treatment - Change in Withholdings $\triangle \mathbf{P}$			Placebo 1 - Change in Withholdings	Placebo 2 - Change in Estimated Payments
	1991 vs. 1992	1991 vs. 1993	1991 vs. 1994	1990 vs. 1991	1991 vs. 1992
Full Sample	−255.10	−271.88	−206.19	−55.70	−32.78
	(44.20)***	(41.29)***	(45.62)***	(22.10)**	(27.10)
	{62.92}***	{58.79}***	{64.95}***	{31.44}*	{38.41}
N	72	72	72	72	72
Single	−157.08	−164.59	−155.37	−45.21	−17.99
	(37.97)***	(41.10)***	(51.10)**	(22.56)*	(37.75)
	{54.68}**	{59.21}**	{73.59}*	{32.48}	{54.21}
N	28	28	28	28	28
Married	−368.93	−410.39	−303.59	−69.04	−58.37
	(51.15)***	(49.29)***	(54.79)***	(40.51)	(39.60)
	{73.18}***	{70.50}***	{78.37}***	{57.93}	{56.59}
N	44	44	44	44	44

Note: Estimates are obtained from a difference-in-difference estimate of the change in withholdings as specified in Equation (8). Data are repeated cross sections from the IRS SOI public use files. Tax filers are aggregated by marital status and year and then into AGI intervals of $10,000. Robust standard errors are reported in parentheses, while those in braces are clustered at the income by marital status level. 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: 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	236.51	59.54	0.30
	{34.39}***	{9.02}***	{0.06}***
	[38.39]***	[10.13]***	[0.07]***
N	13,972	13,972	13,972
Single	180.13	45.06	0.28
	{19.64}***	{6.29}***	{0.08}**
	[19.62]***	[14.50]***	[0.78]
N	9,231	9,231	9,231
Married	391.71	99.39	0.26
	{20.49}***	{14.67}***	{0.12}**
	[22.80]***	[17.89]***	[0.20]
N	4,741	4,741	4,741

Note: Mechanical effects, behavioral responses and adjustment rates are estimated using Equations (10), (11) and (12). Data are from 1992 IRS SOI public use files. The sample is restricted to tax filers with more than 95% of income originating from wages or salary and with incomes within the affected range of the policy change in withholdings. Standard errors, clustered at the income group 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 4: 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	589.52	138.46	0.23
	(30.02)***	(35.31)***	(0.06)***
N	36,548	36,548	36,548
Year 2	618.55	202.42	0.33
	(30.50)***	(41.96)***	(0.06)***
N	25,650	25,650	25,650
Year 3	596.65	342.98	0.51
	(43.90)***	(55.53)***	(0.08)***
N	18,410	18,410	18,410
Controls	Yes	Yes	Yes
Individual, Year FE	Yes	Yes	Yes

Note: Eestimates of mechancial effect, behavioral response and adjustment rate are obtained using Equations (13)-(17). Data are from a panel of US tax filers from the years 1979-1990. Controls include a cubic in AGI, an indicator of age above 65 years, marital status, and year and individual fixed effects. 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: Change in Child Dependents - Salience of Zero Balance

	(1)	(2)	(3)	(4)
	Adjustment Rate: α_L			
	Full Sample		"Zero Balance" Sample	
	Loss	Gain	Loss	Gain
Year 1	0.11	0.32	0.56	-0.20
	(0.16)	(0.13)**	(0.15)***	(0.09)**
N	16,631	17,521	6,202	8,259
Year 2	0.34	0.39	0.78	0.02
	(0.19)*	(0.18)**	(0.15)***	(0.44)
N	11,694	11,401	3,287	2,804
Year 3	0.65	0.68	0.78	0.15
	(0.39)*	(0.19)***	(0.26)***	(0.25)
N	8,220	7,260	2,260	1,941
Controls	Yes	Yes	Yes	Yes
Individual, Year FE	Yes	Yes	Yes	Yes

Note: Estimates of the adjustment rate are obtained using Equation (13). 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 cubic in AGI, an indicator of age above 65 years, marital status, and year and individual fixed effects. 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 6: 1990s EITC Expansion - Adjustment Rate Estimates

	(1)	(2)	(3)	(4)
Adjustment Rate: α_L	-0.25	0.03	-0.02	-0.05
	(0.06)***	(0.05)	(0.04)	(0.03)
Controls	No	Yes	Yes	Yes
Group Fixed Effects	No	No	Yes	Yes
Year Fixed Effects	No	No	No	Yes
N	60	60	60	60

Note: The effect of the EITC changes on prepayments is estimated using data for US tax filers from the years 1990-2004. Tax filers are aggregated by year into four groups depending on EITC eligibility and further by number of children for EITC-eligible tax filers. 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 7: Change in Default Advance EITC Enrollment - Mechanical Effect, Behavioral Response and Adjustment Rate Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
	Advance EITC Enrollment			Weekly Advance EITC Payments		
	Mechanical Effect: $\triangle P_M$	Behavioral Response: $\triangle P_B$	Adjustment Rate: α_P	Mechanical Effect: $\triangle P_M$	Behavioral Response: $\triangle P_B$	Adjustment Rate: α_P
First Renewal:						
First Week	-391	228	0.58	-$10,943	$6,491	0.59
6 Months	-391	321	0.82	-$10,943	$8,989	0.82
Second Renewal:						
First Week	-321	2	0.01	-$8,989	$46	0.01
9 Months	-321	241	0.75	-$8,989	$6,947	0.77

Note: The mechanical effect, behavioral response and adjustment rate are estimated with data from an administrative panel used in [Jones, Forthcoming]. Dollar amounts are reported in year 2000 levels.

Table 8: 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 the appendix.

A Appendix

A.1 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, $\hat{F}_0\left(A_0^i\middle|\,X^i\right)$ and $\hat{F}_1\left(A_1^i\middle|\,X^i\right)$, where X^i is a vector containing income group and marital status.

A.2 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 8.

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:

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

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:

$$\triangle y = \begin{cases} y - \left[\frac{T-1}{T}\left(y-r\right)^{1-\gamma} + \frac{1}{T}\left(y + \left(T-1\right) r\right)^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{when } \gamma \neq 1 \\ y - \exp\left[\frac{T-1}{T}\ln\left(y-r\right) + \frac{1}{T}\ln\left(y + \left(T-1\right) r\right)\right] & \text{when } \gamma = 1. \end{cases} \tag{A.2}$$

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 8 for different values of γ.