Paying Taxes Automatically: Behavioral Effects of Withholding Income Tax

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Abstract

Employers withhold employees' income taxes in nearly all modern tax systems, but the consequences of this arrangement are not well understood. I use IRS administrative data to study how much late payment withholding prevents and why. Exploiting a policy change, I find that withholding reduces late payment substantially. If people pay late because of liquidity constraints, withholding may place harmful limits on their choice to pay late. Yet the liquidity-constraint explanation is inconsistent with evidence that people earning interest income, who are unlikely to be liquidity-constrained, respond just as much to the policy change. Withholding may also help people to avoid the costs and frictions they face when making on-time payments for themselves. Consistent with frictions, I find that late payers make more errors on their tax returns. My findings suggest that withholding both eases the administrative burden of collecting late taxes and benefits taxpayers by making payment automatic.

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1 Introduction

Employers in the U.S. and in nearly all countries surveyed by OECD (2015) must withhold income taxes from their employees' paychecks. Despite large gross tax collections through withholding, which were more than $1.3 trillion in FY 2017, late payments are extensive among taxpayers who owe more tax than the amount withheld—8.2 million taxpayers filed returns with balances not paid by the due date in FY 2017 (Internal Revenue Service (2018), Tables 1 and 16). How much more would people pay late absent withholding, and does withholding help or hinder taxpayers by preventing late payment?

This paper assesses how and why withholding affects late tax payment, using IRS administrative data to examine a 2009 policy change that reduced the amount withheld for some taxpayers. Affected taxpayers and a control group received the same change in total income from the policy, but at different times: affected taxpayers had larger paychecks but smaller refunds or larger balances due at filing. I show that withholding leads many taxpayers to pay on time rather than late, reducing the costs of collecting late payments. Patterns in who responds reveal why people respond. If withholding prevents late payments by fully rational but liquidity-constrained taxpayers, then taxpayers with liquid assets should be less responsive than those without liquid assets. This explanation is not supported by the evidence: I find that taxpayers earning interest income, who are more likely to have liquid assets, are no less responsive than others. If taxpayers pay late because of frictions that affect several decisions at once, like a tendency to procrastinate, late payers should be more likely to make other errors. I find that late payers are more likely to file returns with errors that both overstate and understate their tax liability, consistent with the explanation that withholding reduces late payments by removing frictions from the payment decision.

In the episode I study, policy changes effectively cut 2009 withholding by $250 for households that both earned wages and received certain benefits. Regardless of benefit receipt, a combination of payroll tax credits and one-time direct payments provided households earning wages with $400 ($800 if married filing jointly) of additional after-tax income, but benefit receipt changed how and when the additional income arrived. Households receiving Social Security retirement, Supplemental Security Income, or veterans' disability benefits received an Economic Recovery Payment of $250 in April or May 2009. The payment reduced these households' payroll tax credits by $250, but withholding tables included the full payroll tax credit for all households. While households without benefits had no change in their refunds or balances due at filing, households with benefits had refunds $250 smaller or balances due $250 larger in April 2010. The difference in payment timing between households with and without benefits, holding after-tax income fixed, amounts to a $250 withholding cut for

households with benefits.

I analyze the effects of this policy change using IRS administrative panel data. The panel combines information from tax returns with information from other IRS data sources, including records of IRS-initiated error corrections and notices sent to taxpayers, the timing and amount of direct tax payments, and how long taxes go unpaid, none of which are available in public-use samples. Records of stimulus payments and demographic information come from the Social Security Administration. I select a 2000-2013 sample panel for analysis from data on the universe of taxpayers.

To identify the effects of changing withholding separately from other policy changes and economic shocks, I compare households earning wages with and without a recovery payment–and thus a withholding cut–in years before and after the change. Controlling for pre-treatment demographics including age, marital status, spouse's age, and number of dependents addresses the concern that recovery payment recipients, who earned Social Security retirement, Supplemental Security Income, or veterans' disability benefits, respond differentially to other changes over time. Trends in tax payments are parallel before the policy change during the 2009 tax year. Data from prior years rule out the Great Recession as an explanation for the effect when taxpayers file their tax year 2009 returns in early 2010: neither the prior recession in 2001 nor the early part of the Great Recession affects the parallel trends.

I find that cutting withholding substantially increases late tax payment. Cutting withholding by $250 leads an additional 1.4 percent of taxpayers to pay late. Decreasing withholding increases balances not paid by the due date by an average of five cents for each dollar withholding decreases. Most taxpayers receive a refund and cannot pay late, so the impact is larger among taxpayers with a balance due, for whom decreasing withholding by $250 leads to a 5.7 percentage point increase in late payment and whose overdue balances rise by 20 cents per dollar withholding decreases. Taxpayers whose withholding is cut are more likely to owe money to IRS over the twelve months after filing, at which point the following tax year's refunds provide the IRS with an opportunity to collect some taxpayers' remaining balances due. In tax years following the one-year cut to withholding in 2009, the effect reverses sign: taxpayers subject to the withholding cut are less likely to make late payments in future years, which may reflect taxpayers opting to have more tax withheld. These results imply that cutting withholding raises the cost of collecting late taxes, increasing the overall burden of taxation.

I obtain predictions about which taxpayers respond to changes in withholding from separate models in which people pay late because of binding liquidity constraints or because of frictions in submitting payments. The liquidity constraint model predicts that late payers

would prefer higher present consumption and have exhausted their ability to borrow at interest rates below the interest rate on late payments. Given prevailing interest rates, this model predicts late payers do not also hold savings.[1] Cutting withholding relaxes the liquidity constraint facing those people who would like to pay late. Adding to the model the ability to adjust withholding subject to a minimum preserves this result for a policy change that cuts the minimum level of withholding.

If, instead, frictions such as hassle costs or procrastination lead taxpayers to pay late, those who pay late when withholding is cut may also be more affected by frictions on other margins of behavior. For example, taxpayers whose time or attention is especially valuable when returns and payments are due face higher hassle costs both of making payments on time and of completing accurate tax returns.

Testing the models' predictions using heterogeneous responses to the 2009 withholding cut, I find that the evidence is inconsistent with late payment due to liquidity constraints and instead supports late payment due to frictions. If liquidity constraints lead to late payments, taxpayers holding liquid assets should respond less to a withholding cut. I use interest income as a measure of liquid assets, and find that cutting withholding increases late payments by just as much among taxpayers earning interest income as among other taxpayers. Given lower interest rates on saving than late payment, late payers leave money on the table. This result is robust to capturing liquidity with various measures of interest and dividend income. Late payers are also more likely to file returns with inaccuracies that would both raise and lower their tax bills, failing to claim the MWP payroll tax credit altogether or to report credit-reducing Economic Recovery Payments. Frictions like high costs of time or attention may cause a variety of behaviors, including late payment.

In sum, I find that on the margin withholding reduces the total burden of taxing income through two channels without imposing costs on liquidity-constrained taxpayers. Withholding lowers the costs of collecting late tax payments, and insulates taxpayers from the effects of frictions in making tax payments.

2 Related Literature

While this paper provides the first evidence of the effect of income tax withholding on late tax payment, existing work finds that withholding has effects on other aspects of taxpayer behavior. Chang and Schultz (1990) show a correlation between the amount withheld and

[1]The effective interest rate on late tax payments in 2009 was 9.1 percent annually, compounded on a monthly basis, exceeding the return to most forms of saving but lower than the interest rates then charged on credit card balances or on unsecured personal loans.

income reported, and Rees-Jones (2017) and Engström et al. (2015) find that many taxpayers report liability just below the tax already withheld, in the region where no additional payment is due, a result they attribute to loss aversion. Engström et al. (2015) also use identifying variation in withholding from tax rate rounding to show that even a small balance due leads taxpayers to claim a dubious deduction. While Feenberg and Skinner (1989) find that taxpayers who owe a balance due at filing save more in tax-preferred retirement accounts, Feldman (2010) shows that the 1992 withholding cut instead *reduced* tax-preferred saving in a manner consistent with mental accounts. Although Brockmeyer and Hernandez (2016) study withholding from businesses under a sales tax rather than from individuals under an income tax, they find that a reform that increased withholding led to greater revenue because in the context they study there are high hassle costs of claiming refunds.

Why people pay taxes late remains an open question, but this paper shows that some late payments result from frictions rather than from liquidity needs. Although the model in Andreoni (1992) uses liquidity needs to explain why taxpayers underreport income rather than why they pay late, the model is a natural starting point for a liquidity-driven theory of late payment. Existing empirical work on late tax payments focuses on how to collect payments once they are late, not on why they are late to begin with. Perez-Truglia and Troiano (2015) find that letters emphasizing both financial penalties and shaming work, while Hallsworth et al. (2017) find that letters with descriptive social norm appeals, financial information, and messages regarding public services speed collection. Taken as a whole, the empirical work on late payments emphasizes that when people pay taxes depends on both financial penalties and other factors.

The connection between frictions and timely tax payment parallels the role of frictions in take-up of a range of tax and non-tax benefits. The evidence shows that institutional and informational details matter. Simplified mailings increase EITC take-up (Bhargava and Manoli (2015)), as do reminders targeted at inattention (Guyton et al. (2017)). The earnings response to the EITC depends on information about the tax code (Chetty and Saez (2013)). How information is presented affects tax-advantaged retirement saving (Saez (2009)). Behavioral factors may reduce take-up of unemployment insurance (Blank and Card (1991)). Simplicity and user-friendliness are key design principles not only for distributing benefits, but also for collecting information and revenue.

Even when information about tax liability is plentiful, employer withholding lowers the resource costs of collecting taxes from wages and salaries, perhaps because withholding avoids the challenges of using information effectively. Compared to income from sources subject only to information reporting, taxpayers report more of their income from wages, which are subject to both information reporting and withholding (Internal Revenue Service (2016),

Kleven et al. (2010)). Dusek and Bagchi (2017) find that revenues increase 28 percent when U.S. states adopt both information reporting and employer withholding.

Given the relative ease of collecting revenue through employers, it is not surprising that the employer-employee nexus is the linchpin of modern tax systems. The U.S. government's revenues come mostly from withheld income taxes and payroll taxes, both remitted by employers. The U.S. is not alone. Fifty of the fifty-five countries surveyed by OECD (2015) require employers to withhold income tax from wages and salaries. Jensen (2016) uses historical evidence from the U.S. and across countries to show that the income tax only applies to income groups that are at least 80 percent employees. Something is different about the ability to tax wages and salaries that explains the effectiveness of modern tax systems, and withholding is one candidate explanation for that difference.

The finding that withholding alters tax burdens contributes to a recent empirical literature that challenges the traditional view in public finance that the burden of taxation does not depend on who remits the tax. Kopczuk et al. (2016), for example, find that diesel tax evasion changes when remittance responsibility is shifted to a different level of the production chain. Placing the remittance responsibility with employers reduces the burden of taxation by removing the additional friction-driven costs taxpayers bear when making payments and the additional administrative cost of collecting late taxes.

3 Employer Withholding in the U.S.

U.S. policy aims to match the income tax each household pays during the tax year to the total tax liability on their tax return, in keeping with the legal requirement that tax is due when income is earned. During the tax year, tax is paid in two ways: people directly pay estimated tax, and employers withhold tax from their employees' paychecks. The amount withheld depends on marital status and on wages, from which allowances for deductions and credits are subtracted. The default amount withheld assumes the employee is single and has no allowances, and so exceeds most employees' liability. Employees can file a form with their employers to adjust the amount withheld, updating marital status and allowances or claiming an exemption from withholding. There is no upper limit on the tax employees can request be withheld–they can write in an arbitrary additional amount to withhold. There is, however, a lower limit on withholding, because employees cannot claim allowances for more credits and deductions than they receive, and can only claim an exemption from withholding if they owe no tax. The IRS sends letters to employers locking in higher levels of withholding for employees who set withholding too low.

After the tax year, taxpayers file returns and settle up with the government. Returns are

due in the middle of the following April. If the amount withheld or submitted directly as estimated taxes exceeds tax liability, the taxpayer receives a refund of the excess payment, without interest. If payments during the tax year are less than tax liability, the remaining tax is due as a direct payment by the mid-April filing deadline. In cases where payments during the tax year are much lower than tax liability, the IRS charges interest.[2]

During the 2009-2010 period, the penalties and interest charged on late taxes totaled 9.1 percent over the first year, compounded monthly[3]. The interest rate charged on late tax payments is therefore less than the rate charged by credit cards, which averaged 13 to 15 percent in 2009-2010 (Board of Governors of the Federal Reserve System (2018)), but much higher than the interest rate on bank deposits or other liquid savings.

IRS sends people who owe late tax a bill, then a second bill, before turning to other means to collect. After the second bill, the IRS will subtract the unpaid amount from any future refunds. An IRS employee may also visit the taxpayer in person, and can attempt to collect through levies against sources of income or assets and through liens against or seizures of property.

The withholding system relies on employers' cooperation, which is strictly enforced. The executives responsible can be personally liable for any withheld tax the employer does not remit. In this paper, I set employer behavior aside. In practice most but not all employers cooperate. In Boning et al. (2018), my coauthors and I find that enforcement contact has large effects on the withheld tax remitted by the few potentially uncooperative employers, and smaller spillover effects on the tax remitted by other employers sharing the same tax preparer.

4 Policy Variation and Data

Interactions between two stimulus policies in the 2009 American Recovery and Reinvestment Act effectively cut withholding by $250 for some employees, who then had either smaller refunds or larger balances due than a control group. The act otherwise had similar consequences for the two groups. I follow both groups in a panel of administrative tax data. A difference-in-difference approach identifies the effect of collecting more tax directly from taxpayers instead of through employer withholding.

[2]Interest, called the estimated tax penalty, is typically due if payments during the tax year are less than ninety percent of the year's tax, with some exceptions.

[3]The penalty for late payment is 0.5 percent of the unpaid tax per month (up to a maximum of 25 percent), plus monthly interest at the federal short-term rate plus three percentage points. This calculation also assumes the taxpayer files on time, avoiding the substantial penalty for failure to file of five percent of the tax due per month up to a maximum of 25 percent.

4.1 Policy Changes

Households with income from both wages and certain government benefits received an additional $250 from stimulus policies during the 2009 tax year but also had refunds that were $250 smaller or balances due that were $250 larger when filing their 2009 tax returns. These changes are relative to households earning wages but not receiving the relevant benefits. The two groups had their taxes collected at different times, through different methods, but eventually the policy changes gave both groups the same amount of additional income. The difference was due to an interaction between the Making Work Pay payroll tax credit and one-time Economic Recovery Payments to benefit recipients.

The Making Work Pay (MWP) payroll tax credit cut fully eligible employees' 2009 and 2010 tax bills by up to $400 per year, or $800 per year if married and filing jointly. The credit was refundable. The credit amount was a function of earned income, which included wages, certain kinds of self-employment income, and non-taxable combat pay. The credit was phased in at a rate of 6.2 percent up to the full amount of credit at earned income of $6,451 ($12,903 if married filing jointly), remained at the maximum at earned income up to $75,000 ($150,000), and then phased out until households with earned income of $95,000 ($190,000) received no credit.

Each person eligible for Social Security or railroad retirement benefits, Supplemental Security Income benefits[4], or veterans' disability or survivorship payments received an Economic Recovery Payment (ERP) of $250 in April or May 2009. Each person received at most one Economic Recovery Payment, though a couple filing jointly could receive two. The government agencies providing benefits sent payments to 55.2 million taxpayers, mostly by direct deposit, with the rest sent by mail. It is unlikely that taxpayers selected into receiving a payment. To receive a payment, one had to be eligible for benefits during November 2008, December 2008, or January 2009, the final three months before the Recovery Act passed, but the payments were added to the act in conference committee in February 2009.

The Economic Recovery Payment counted against the MWP payroll tax credit. Households with both wages and an Economic Recovery Payment were eligible for at most $150 ($550) of MWP credit. MWP credit amounts less than $250 were reduced to zero.

Tax year 2009 withholding fell by the full MWP credit amount for all employees earning wages, regardless of eligibility. A single employee whose only income was wages of $60,000, for example, received an additional $400 in her paychecks. As she was eligible for the full $400 MWP credit, her withholding and tax liability changed by the same amount. Her refund or balance due for tax year 2009 was similar to her refund or balance due in prior tax

[4]because of blindness, disability, or low income while over 65

years. The amount withheld did not depend on the amount of the MWP credit for which the employee was eligible. As a result, taxpayers who were not fully eligible for the MWP credit, including those receiving Economic Recovery Payments, had either larger balances due or smaller refunds with their 2009 returns.

Consider a single taxpayer whose wage income was $60,000 and who received an Economic Recovery Payment. His MWP credit was $150 and the Economic Recovery Payment gave him another $250, so he kept final benefits totaling $400. If he had not received an Economic Recovery Payment, he would have kept the same amount, distributed only through the full MWP credit. His withholding was incorrectly cut by the full MWP credit of $400, but the MWP credit he could claim on his 2009 tax return was only $150. As a result, his 2009 tax return would show a refund $250 smaller or balance due $250 larger than if he had not received an Economic Recovery Payment.

Employees could have had more tax withheld to offset the policy change, but such changes are uncommon. Withholding policy sets a default subject to taxpayer adjustment, and Jones (2012) finds substantial inertia around the default–after a policy change cut withholding in 1992, employees adjusted withholding slowly or not at all. The form employees use to adjust withholding is not filed with IRS, but with employers, so I do not observe withholding adjustments. Employees' withholding adjustments would cause the effect of withholding estimated in this paper to be a lower bound relative to the effect if employees could not adjust withholding. Given that taxpayers can adjust, the effect estimates in this paper are the relevant estimates for withholding policy.

4.2 Data and Sample Construction

I bring together information from several IRS administrative databases to construct a panel that follows households in the treatment and control groups over tax years 2000-2013. To obtain comparable numbers of control and treated households, I randomly sample 1 percent of the overall population and 10 percent of the population of Economic Recovery Payment recipients. I restrict both groups to those with enough wages to have $250 of tax credit for the payment to offset, producing a reduction in withholding. Pre-treatment differences between treated and control taxpayers are consistent with payment receipt depending on retirement or disability benefit receipt. These differences are addressed by the difference-in-difference empirical strategy I employ.

Data come from taxpayers' returns as well as from the results of IRS automatic error-detection checks, IRS records of payments received and unpaid taxes, and Social Security

Administration records of demographics and Economic Recovery Payment receipt[5]. Data are at tax-year frequency, with the exception of monthly data on amounts owed to IRS. Data are available from 2000-2013 for most variables, though payment amount data are only comprehensive beginning in 2003.

By definition, households in the treatment group received exactly one Economic Recovery Payment, and households in the control group received no Economic Recovery Payment. I restrict to households by keeping only the primary filer in couples filing jointly. I limit panel imbalances across tax years by restricting the sample to taxpayers between the ages of 30 and 70 in 2009. I restrict both groups to households who earned wages between $4033 and $82,500 ($177,500 if married filing jointly). This restriction is necessary for the the policy interaction to have the full $250 effect on how and when tax was collected. Instead of wages from tax year 2009, which may respond to the MWP payroll tax credit, the restriction uses wages from tax year 2008. Powell (2015) and Mortenson and Whitten (2016) find that taxpayers report self-employment income or incorrect 2009 wage amounts to obtain the full MWP payroll tax credit. Wages from the two years are highly correlated, and the restriction is broad, so results do not substantially depend on whether the restriction uses 2008 or 2009 wages.

The outcomes I study are an indicator for whether the taxpayer paid the full amount due with the return, the dollar amount of payment by the deadline net of the balance due with the return, which is winsorized at the 1st and 99th percentiles, and the percentage of the remaining balance due with the return that is not paid by the deadline. Taxpayers owed a refund are counted as fully paid and counted as having zero payment net of balance due.

4.3 Characteristics of Treatment and Control Group Households

Households in the treatment and control groups differ before treatment, but my empirical strategy minimizes concerns about these differences. One would expect that households eligible for retirement or other benefits would differ from other households, and in fact two thirds of households in the the treatment group receive Social Security retirement benefits in 2008, as shown in Table 1. The treated group are older, averaging 58 years of age versus 41. Treated households are ten percentage points more likely to be married filing jointly, and on average claim 0.5 fewer dependents. They average $41,000 of wage income, less than the control group's $59,000. There is a smaller difference in adjusted gross income, which measures taxable income from a wider range of sources, from $61,000 in the treated group to $68,000 in the control group. Treated households earn more interest income from both

[5]The payment receipt records are comprehensive regardless of the agency distributing the payment

taxable and tax-exempt sources, on average about $1,400 versus $800. Differences between the treatment and control groups are addressed by my empirical strategy, in which I use a difference-in-difference estimation approach and controls for time-varying effects of pre-treatment demographics. When considering whether the empirical results for the treated group might apply to taxpayers more generally, it is worth noting that the treatment group are on average younger than retirement age and earn substantial wage income.

A large majority of both groups pay on time. The treated group on average receive smaller refunds, but are equally or slightly more likely to pay and file on time before treatment. In both groups in 2008, about 95.5 percent of taxpayers fully pay the tax due with their returns. The control group on average pay $129 less than the balance due, failing to turn in 4.05 percent of the balance of tax due with the return, while the treated group on average pay $113 less than the balance due, paying all but 3.99 percent of the balance due. Among the treated group, 96.4 percent file on time, slightly more than the 95.3 percent of control group timely filers.

Conditional on owing a balance due, households in both groups are much less likely to pay on time. Only 80 percent of treated households owing a balance due pay it in full in 2008, and 72 percent of control group households. On average, treated households owing a balance due leave $500 unpaid, compared to $800 in the control group.

The treatment affects treated households' returns as expected, reducing the treated group's Making Work Pay payroll tax credit in 2009 relative to the control group. Table 2 shows that the treated group on average receive $196 less ($351 rather than $545) Making Work Pay tax credit than the control group. This $196 is less than the full $250 reduction the policy would otherwise induce because I predict a credit that depends on 2009 earned income using 2008 wages, so that changes in wages between the two years or certain other income items could attenuate the extent of treatment. However, for the majority of the treatment group the credit is reduced by exactly the full $250 from the maximum possible credit, with 16 percent of treated households receiving a credit of exactly $150 and another 47 percent receiving exactly $550. Most treated taxpayers would receive the full credit but for the interaction with the ERP check, which would result in a credit of $150 if single and $550 if married filing jointly[6].

[6]Households could also have exactly this much credit due to earned income on the phase-in or phase-out regions of the credit schedule, but such situations are rare, as illustrated by the fact that less than one half of one percent of control group households earn exactly this much credit.

5 Empirics: Main Effects

5.1 Difference-in-Difference Specification

I use a difference-in-difference approach to compare the changes in the tax compliance behavior of the treated and control groups over time. The identifying assumption is that trends in behavior between the treatment and control groups would remain parallel absent the policy change.

The stimulus act also increased the earned income tax credit available to certain households with three or more dependents beginning in 2009, so I conduct a robustness check in which I exclude households with three or more dependents in 2008, reported in Table A.2. To my knowledge, no other legislative or IRS policy changes in 2009 could confound the results by differentially affecting the treatment and control groups.

Restricting to the treatment and control groups defined above, I estimate the average treatment effect with the following event-study version of the difference-in-difference specification, which interacts baseline demographics with year fixed effects.

$$y_{it} = \alpha_i + \sum_t \beta_t ERP_i + \sum_t \gamma_t X_i + \varepsilon_{it}, \tag{1}$$

where $y_i t$ is an outcome measure for household i in time period t, α_i is a household fixed effect, β_t is the effect of a \$250 reduction in 2009 withholding on the outcome variable y in time period t, ERP_i is an indicator equal to one for if the household received exactly one Economic Recovery Payment in 2009 and zero otherwise, $\gamma_t X_i t$ is a vector of time-varying effects of pre-determined covariates, and $\varepsilon_i t$ is an error term.

The treatment and control groups differ in background characteristics such as age that affect the time path of taxpayer behavior over several years' time, so I control for time-varying effects of characteristics determined before the policy was announced. Specifically, I control for interactions between year fixed effects and: age fixed effects, age of spouse in 2008, if any, filing status in 2008, and dependents in 2008. In the monthly data on debts to IRS, I address seasonality in the difference between the treated and control groups by removing month-of-year-by-treatment fixed effects estimated using the data from the pre-treatment period.

The coefficients of interest are the effect of the reduction in withholding beginning in 2009, when the reduction took place, captured by β_t where $t > 2008$. Rather than imposing a single coefficient for 2009 and later years, these coefficients capture the effect for each tax year separately. The specification also directly provides a placebo test: the trends in the outcomes between the treated and control groups should be parallel prior to treatment in

the 2009 tax year.

5.2 Main Effects Results

Estimating specification 1 reveals four facts. First, taxpayers whose withholding is reduced by $250 in 2009 are more likely to pay late, and pay larger amounts late, with larger effects among taxpayers owing a balance due. Second, the resulting tax debts last up to one year. Third, taxpayers whose withholding is reduced are less likely to pay late in future years. Finally, the evidence from pre-treatment years supports the identifying assumption that absent the policy change the difference in late payment between the treatment and control groups would be similar across years.

When taxpayers are required to make more tax payments directly, they are less likely to pay in full, leave larger balances due unpaid, and pay a smaller fraction of the balance due. The difference-in-difference estimates are reported in Table 3 and depicted in Figure 1, Figure 2, and Figure 3. Treated taxpayers are 1.43 percentage points less likely to remit the full amount due with their 2009 returns. The treated group on average pay $13 less of their 2009 taxes by the due date, which is five percent of the $250 reduction in withholding. Averaging across taxpayers, the treated group pay 0.7 percentage points less of the dollar amount due with the return. All of these results are highly statistically significant.

The magnitudes of the late payment effects are about four times larger after excluding the majority of taxpayers due a refund, who cannot pay late. If one restricts each year's sample to taxpayers with a balance due, as in Table 4, the withholding change leads taxpayers with a balance due to be 5.6 percentage points less likely to pay in full. This is a large change, but is reasonable when compared to the 72 percent of control group taxpayers with a balance due who pay in full in 2008. Among taxpayers with a balance due, the effect of the $250 reduction in 2009 withholding is a $50 decline in average net payments relative to the balance due, a large effect but reasonable given that the control group taxpayers owing a balance due left an average of $822 unpaid in 2008. Late payment is highly responsive to the balance of tax due at filing, and therefore to withholding.

Taxpayers whose withholding was reduced by $250 are significantly less likely to be free of debts to IRS for a year after the deadline. Figure 4 shows that the two groups' likelihood of being free of tax debt is roughly comparable prior to a dramatic spike downward for the control group following treatment, in which many treated taxpayers owe tax debts. The period of the spike, depicted in detail in Figure 5, begins during the 2009 tax year filing season in March and April 2010. The spike in tax debts peaks in May and June 2010, which trails the filing and payment deadline in mid-April because late payments are not added to

the month-by-month debt data until after an initial notice period. The effect then diminishes over time and finally becomes no longer significant in either economic or statistical terms in May 2011. The unwinding of tax debt among the treatment group relative to the control group during the 2010 filing season suggests that some of the additional late payments may have been collected by reducing the refund amounts for taxpayers with a 2010 refund and remaining tax debt from tax year 2009. Excess withholding, and the resulting refunds, enables IRS to more cheaply collect late taxes from prior years. The magnitudes of the point estimates for no debt to IRS in Table 5 are smaller than for the full payment indicator because some taxpayers who do not pay in full by the deadline pay in full during the notice period that precedes addition to the debt data.

I assume that tax is paid eventually, and do not explicitly address the few taxpayers who may set withholding as low as possible with the goal of never paying the tax they owe. I find that treated taxpayers are not more likely to owe tax debts beyond one year after the deadline, which suggests that few taxpayers may attempt to never pay, or that the change I study may not affect them on the margin.

In the years after withholding was cut, treated taxpayers become *more* likely to pay on time relative to the control group, a reversal of the results for 2009. The magnitudes of the reversed effects are much smaller than the 2009 effects. The treated group are 0.2 percentage points more likely to pay in full in 2010, after having been 1.4 percentage points less likely to pay in full in 2009. This reversal is consistent with taxpayers requesting that their employers make adjustments to withholding or changing other behaviors to avoid the negative consequences of the withholding cut or of paying late. It is also consistent with a taxpayer preference for higher withholding, perhaps as a safeguard against the costs or frictions of making a direct payment.

For all three measures of late payments, the parallel pre-trends assumption is supported by data on the several years before treatment. While in some pre-treatment periods individual coefficients are statistically significant at the $p < 0.05 level$, no coefficient is statistically significant at the $p < 0.01$ level, and this may reflect the power the large sample size provides to detect even economically insignificant deviations from perfectly parallel pre-trends. The magnitudes of the pre-treatment coefficients are much smaller than the 2009 effects: for the fully paid indicator no pre-treatment coefficient is more than one tenth the magnitude of the 2009 coefficient, while for the dollar value and percentage of balance due underpaid the pre-treatment coefficients are no larger than approximately one fifth the size of the 2009 coefficient.

The estimated effects do not appear to be driven by differential exposure to the Great Recession between treated and control groups. The evidence from years before 2009 is not

consistent with differences driven by recessions. During the previous recession in 2001, the treated group is if anything more likely to pay in full, not less, relative to the 2008 difference. The Great Recession took place over multiple years, including parts of 2007, 2008, and 2009. If the treatment group are especially likely to pay late when economic circumstances worsen, then one would expect that the treatment group's compliance would be substantially higher in relative terms in good years, with lower values in the 2007 and 2008 tax years. This is not what the figures show: the 2009 effect is isolated to a single year, with no evidence that late payments by treated and control taxpayers diverged in the earlier years of the Great Recession.

These results are robust to restricting the analysis to taxpayers who are married and file jointly or to households with fewer than three dependents in 2008. Restricting to married taxpayers filing joint returns, as in Table A.1, removes the concern that the estimated effects could be due to filing status differences between the treated and control groups. Including only households with two or fewer dependents in 2008, as in Table A.2, addresses the concern that the 2009 expansion of the EITC for those with three or more dependents could affect the results.

6 Withholding as Forced Saving and Automatic Payment

Withholding, or "pay as you earn", has two meanings. In one sense, paying as you earn means paying *when* you earn. Withholding forces payment on time, and can have similar consumption effects to forced saving. Forcing fully rational employees whose ability to borrow is limited by liquidity constraints to pay on time harms them because it overrides their preference. In another sense, paying as you earn means that you pay simply *by earning*. Payment happens automatically as employees earn income and is out of their hands. Automatic payment may benefit taxpayers who would otherwise pay late because of frictions or costs, including hassle costs, time costs of making accurate payments, costly attention, or procrastination.

6.1 Liquidity Constraints and Withholding as Forced Saving

Withholding harms taxpayers subject to binding liquidity constraints, who are unable to borrow as much as they would like to finance current consumption. In a model of liquidity constraints, withholding only affects those taxpayers who cannot borrow at interest rates lower than the interest rate charged on late tax payments, and does not affect taxpayers

who choose to save. This is still the case if taxpayers are allowed to can adjust the amount withheld subject to a lower limit.

Consider a simple model in which there are two periods. The first period includes the tax year up through the deadline for tax payment, while the second period is a later date at which late payments are made with interest. The taxpayer's utility is $U(C_1, C_2) = u(C_1) + \delta u(C_2)$. The taxpayer earns taxable income Y_1 during the tax year, which is subject to income tax $\tau(Y_1)$, and receives an untaxed bequest B_2 in the second period, which may lead the taxpayer to wish to borrow to smooth consumption.

Financial market frictions cap the taxpayer's ability to borrow at a fixed sum, which I set to zero without loss of generality. The taxpayer chooses savings $S \geq 0$, which earn a gross interest rate R_S.

An amount set by government policy H is withheld from the taxpayer's income in the first period, and credited against the taxpayer's tax liability. The taxpayer chooses an additional amount of tax to pay in the first period, $\Pi \geq 0$. Excess payments are refunded withhout interest, and tax that is not paid in the first period incurs interest at rate R_D. I assume $R_D > R_S$, as the interest charged on late tax payments exceeds interest on savings in practice. This immediately implies that the taxpayer will either save or pay taxes late, but not both, as such points are strictly inside the budget constraint. A taxpayer who both saves and pays late could engage in arbitrage by instead devoting the saved income to timely payment, earning $R_D - R_S > 0$ and increasing consumption in one or both periods.

If there were no financial frictions to limit borrowing, withholding an amount less than the tax liability due would have no effect in this model, and withholding in excess of the tax due would have only a negative income effect due to forgone interest. Private borrowing at rate $R_S < R_D$ would dominate late tax payment. The taxpayer's first order condition would only depend on withholding in excess of tax liability,

$$u'(C_1) = \delta R_s u'(R_S[Y_1 - \tau(Y_1) - C_1] + B_2 - [R_S - 1]\max\{0, H - \tau(Y_1)\}), \tag{2}$$

and only because of an income effect from forgone interest on the refund amount.

Returning to a model with liquidity constraints, the taxpayer cannot pay late if withholding exceeds liability, $H > \tau(Y_1)$, so to study late payment I consider the case where $H < \tau(Y_1)$. The intertemporal budget constraint consists of three segments, with two kink points. In the first period, the taxpayer's budget constraint is $C_1 \leq Y - S - H - \Pi$. Given the chosen levels of saving S and direct tax payments Π, the taxpayer's second-period budget constraint is $S \geq 0$ and:

$$C_2 \leq R_S S + B_2 - R_D(\max\{\tau(Y_1) - H - \Pi, 0\}) + \max\{H + \Pi - \tau(Y_1), 0\}. \tag{3}$$

The maximum possible second-period consumption occurs when the taxpayer pays the full tax bill on time and saves the remaining income, at the point where $C_1 = 0$ and $C_2 = R_S(Y_1 - \tau(Y_1)) + B_2$. At this point, the taxpayer can obtain an additional dollar of consumption in the first period by saving less, forgoing R_S in the second period. The budget constraint has constant slope $-R_S$ until the point at which consumption in the first period is $Y_1 - \tau(Y_1)$ and the remaining income is devoted to paying the full tax bill on time, with saving $S = 0$ and consumption in the second period $C_2 = B_2$. At this point there is a kink in the budget constraint, as further first-period consumption requires late tax payment and thus forgoing second-period consumption R_D. From this point the budget constraint is linear until first-period consumption is maximized by setting $S = 0$, $\Pi = 0$, and $C_1 = Y - H$, with second-period consumption $B_2 - R_D(\tau(Y) - H)$. At this point, further borrowing is prevented by financial frictions, and the budget constraint kinks again, becoming vertical until it connects to the horizontal axis.

Withholding only affects taxpayers for whom the liquidity constraint is binding - it does not enter the utility function, and appears in the realized budget constraint only when preferences lead the taxpayer to make no additional non-withheld tax payment. The possible solutions occur at the two kink points and on the segments with slope $-R_S$ and $-R_D$, and depending on preferences, the interest rate charged on late tax payments, and the size of the second-period bequest relative to first period net of tax income. On the segment where the taxpayer saves, solutions occur with the standard tangency between the indifference curve and budget constraint, and satisfy

$$R_S = \frac{u'(C_1)}{\delta u'(B_2 + R_S[Y_1 - \tau(Y_1) - C_1])}. \tag{4}$$

At the kink point where the taxpayer neither saves nor pays late, the following inequality holds:

$$R_S \leq \frac{u'(Y_1 - \tau(Y_1))}{\delta u'(B_2)} \leq R_D. \tag{5}$$

On the segment where the taxpayer does not save and pays late, the solution satisfies:

$$R_D = \frac{u'(C_1)}{\delta u'(B_2 - R_D[\tau(Y_1) - Y_1 + C_1])}. \tag{6}$$

Finally, withholding does enter the solution condition when the liquidity constraint binds and the taxpayer would like to pay even the withheld tax late, where

$$R_D \leq \frac{u'(Y_1 - H)}{\delta u'(B_2 - R_D[\tau(Y_1) - H])}. \tag{7}$$

The comparative static with respect to an increase in withholding given that the taxpayer's full tax liability is not already withheld is as expected: withholding does not affect taxpayers for whom it is not a binding constraint, while it reduces the welfare of taxpayers for whom the liquidity constraint binds by restricting their ability to pay late, forcing first period consumption lower relative to second period consumption in contrast to their preferences. For taxpayers making any additional non-withheld tax payment, the additional payment falls one-for-one with the increase in withholding, with no further changes. For taxpayers choosing to make no non-withheld tax payment, $\frac{\partial C_1}{\partial H} = -1$, $\frac{\partial C_2}{\partial H} = R_D$, and the effect on utility is obtained by substituting into 7:

$$\frac{\partial U}{\partial H} = -u'(C_1) + \delta R_D u'(C_2) \leq 0. \tag{8}$$

6.1.1 When Taxpayers Can Adjust Withholding

Allowing taxpayers to adjust withholding subject to a lower limit (enforced, for example, by rules requiring employers to withhold at at least this level) does not substantially change the results of this model, except to recast it in terms of the lower limit $\bar{H}$ rather than the previous policy-fixed level H. The potential budget constraint given flexibility to choose $H \geq \bar{H}$ mirrors the above, except with the liquidity constraint binding at the lowest possible level of withholding $\bar{H}$.

Taxpayers who would pay non-withheld tax given withholding of $\bar{H}$ are indifferent to the level of withholding so long as it is below their preferred total first-period tax payments. Taxpayers who would like to pay less tax on time than the minimum level of withholding $\bar{H}$ are liquidity constrained, with the result that increasing the minimum level of withholding harms these taxpayers.

While this model omits the estimated tax penalty employees owe if withholding (and estimated tax payments made during the tax year) is too low relative to tax liability, adding the penalty does not substantially change the model. For example, if the penalty applied to the difference between withholding and tax liability, taxpayers would choose to set withholding equal to their total desired first-period tax payments to minimize the penalty, making no additional non-withheld tax payments. The estimated tax penalty would then be absorbed into a higher R_D charged on late payments.

The liquidity-constraint model does not explain why many taxpayers are overwithheld, receiving refunds following tax filing. Adding uncertain non-labor income not subject to withholding in combination with the estimated tax penalty for insufficient withholding could generate this result. Alternatively, taxpayers might choose to be overwithheld as a commitment device that forces saving, or due to inertia around a high default level of withholding,

as in Jones (2012).

6.2 Frictions and Withholding as Automatic Payment

A wide variety of costs or decision-making frictions could explain why withholding reduces late payments. These costs or frictions should explain why taxpayers pay, but not on time, given the penalties and interest late payment incurs. One example is hassle costs that are convex in the time spent preparing and filing taxes, and procrastination is another example, though many other non-monetary costs or frictions would fit within this framework.

6.2.1 A General Model of Payment Frictions

Beginning with the model developed above, suppose instead that the taxpayer is not liquidity-constrained and can save and borrow freely at rate $R_S < R_D$. The taxpayer behaves as though making a direct tax payment Π costs not only the amount paid, but also an additional time-dependent amount $f_t(\Pi)$, with $f_t(0) = 0$ and $f_t'(\cdot) \geq 0$. This payment may include a fixed cost of making any positive payment, a variable cost component increasing in the amount of payment, or both.

The taxpayer's per-period utility is linear in income, and late payments are repaid in the second period, $C_1 - f_1(\Pi) + \delta[C_2 - f_2(\tau(Y_1) - H - \Pi)]$.

The timely payment amount Π is chosen to maximize

$$-H - \Pi - f_1(\Pi) - \delta R_D \max\{\tau(Y_1) - H - \Pi, 0\} - \delta f_2(\tau(Y_1) - H - \Pi). \tag{9}$$

At an interior solution where the taxpayer makes an additional tax payment that is less than the full balance due,

$$-1 - f_1'(\Pi) + \delta R_D + \delta f_2'(\tau(Y_1) - H - \Pi) = 0, \tag{10}$$

or equivalently $\delta R_D - 1 = f_1'(\Pi) - f_2'(\tau(Y_1) - H - \Pi)$. If the cost is independent of timing, $f_1(\cdot) = f_2(\cdot)$, but has an intercept of zero is convex and increasing in the amount paid, with $f'(\cdot) > 0$ and $f''(\cdot) > 0$, then the result will be an interior solution.

Alternatively, if the friction is a fixed cost of making any payment regardless of the amount paid, then taxpayers will either pay the full amount on time or the full amount late. The corner solution where the taxpayer pays the full remaining balance due on time has value $-\tau(Y_1) - f_1(\tau(Y_1) - H)$, while the corner solution where the taxpayer makes no additional payment on time has value $-H - R_D(\tau(Y_1) - H) - f_2(\tau(Y_1) - H)$. Taking the difference gives $[R_D - 1](\tau(Y_1) - H) + f_2(\tau(Y_1) - H) - f_1(\tau(Y_1) - H)$. Delaying payment is

worth the interest paid if making the payment on time results in a friction cost sufficiently high relative to making the payment late. If $f(\cdot)$ has both a fixed and variable component, then the optimum may lie at either the interior solution or at one of the corners, depending on parameter values.

Late payment occurs because payment costs or frictions are higher at filing time than afterward. There are many possible interpretations of $f(\cdot)$; it could, for example, be a fixed time or mental effort cost of making the payment, which combined with being busier during filing season than afterwards makes waiting until after the deadline to pay more attractive. Procrastination, another potential explanation, makes the present-period costs relevant for the decision of when to pay appear larger. The monetary of making the payment e.g. by check, online transfer, or wire transfer is likely small and unlikely to vary over time, absent liquidity constraints.

6.2.2 Hassle Costs of Tax Filing and Payment

Withholding can generate welfare gains by, for example, eliminating the hassle costs of making payments. Making payments on time involves much higher hassle costs than paying late because paying on time requires additional time and effort on top of the time and hassle of filing a return, while paying late allows the taxpayer to make a payment when time effort are easier to come by. Taxpayers subject to high hassle costs at filing time spend less time not only on payment and verifying the payment amount, but also on verifying other items on the tax return. Higher hassle costs could be higher for higher-income taxpayers, whose opportunity cost of time is higher, and who thus are more likely to respond to a change in withholding.

Suppose that the hassle of spending time and effort to file and pay taxes is convex in the fraction of a time period spent on tax filing and payment. The hassle cost function is $\psi(e)$, with $\psi(0) = 0$, $\psi'(e) > 0$, and $\psi''(e) > 0$. The marginal cost of the additional effort spend to figure out the right payment amount and make the payment is higher before the tax filing and payment deadline in April because of the effort already exerted around this time to file a tax return. Delaying payment until after the deadline costs interest and penalties, but reduces the hassle cost of the effort payment requires. Specifically, suppose that filing requires effort $e_f > 0$, and payment requires effort $e_p > 0$. Then, the convexity of $\psi(e)$ implies $\psi(e_f + e_p) > \psi(e_f) + \psi(e_p)$.

If less than the full tax liability is withheld, the taxpayer bears a hassle cost of making the payment. The taxpayer chooses whether to exert the effort e_p to make a payment when filing, avoiding penalties and interest, or after filing, with penalties and interest on the tax

paid late. The taxpayer chooses to pay late when

$$\psi(e_f) + \psi(e_p) + [R_D - 1](\tau(Y_1) - H) < \psi(e_f + e_p). \tag{11}$$

If the hassle cost of making a payment does not depend on the payment amount, increased withholding reduces the interest cost of paying late, conditional on needing to make a payment. This effect of withholding can make late payment more common.

Hassle costs of this form imply that the same taxpayers will pay late and make mistakes in filing. If some taxpayers have especially high costs of time or effort exerted when filing, for example, then similar logic applies both to their decision to pay late and to their decision to cease expending additional effort to verify that the tax return is correct. Let the expected cost of inaccuracies on the tax return given filing effort e_f be $i(e_f)$, with $i'(\cdot) < 0$ and $i''(\cdot) > 0$, so that effort has decreasing marginal returns. Then the first order condition for filing effort sets $\psi'(e_f) = i'(e_f)$. If taxpayer j has an attribute, for example a complicated tax situation, that shifts the effort cost of filing upward by a_j, then $\psi'(e_f + a_j) = i'(e_f)$ yields a lower e_f and higher mistakes, captured by a lower value of $i(\cdot)$. The same attribute would also make late payment more likely due to the convexity of ψ, which increases the savings from paying late:

$$\psi(e_f + a_j + e_p) - \psi(e_f + a_j) - \psi(e_p) > \psi(e_f + e_p) - \psi(e_f) - \psi(e_p). \tag{12}$$

Hassle costs thus generate the result that the same people will make mistakes on their returns and pay late.

Hassle costs are likely higher for higher-income taxpayers, who tend to have more complex tax situations, increasing both the effort required to file e_f and the effort cost of determining and making the correct payment e_p. Higher wage rates imply a higher opportunity cost of time, so that even a similar time investment in accurate payment imposes a larger burden on higher-wage and therefore higher-income taxpayers. Higher-income taxpayers may also have larger balances due, even though withholding increases with the tax liability due on wages, because of higher income from sources not subject to withholding, although this can be offset by adjusting withholding upward or by making larger estimated tax payments.

Higher hassle costs for higher-income taxpayers imply that for a given balance due they are more likely to pay late, and withholding that eliminates the need to make a payment will have a larger effect for higher-income taxpayers. Withholding can have substantial benefits if it removes hassle costs of payment altogether, as such costs indicate resources otherwise devoted to making payments.

6.2.3 Procrastination

Procrastination can lead taxpayers to pay late. Present bias or simple impatience overvalues the costs of paying today relative to the costs and benefits of paying tomorrow. The costs of making a timely payment include penalties and interest, but also include the time and effort involved in determining the payment due and to make the payment and psychological costs due to loss aversion. If enough is withheld that no additional payment is due, then withholding completely removes the opportunity for procrastination to interfere with making tax payments.

Consider a naive present-biased taxpayer deciding when to pay. Let R_S be the gross interest rate on private saving or borrowing, H the amount withheld, and $\tau(Y)$ the tax due. For simplicity, assume that payment is a binary choice in each period between paying the full balance due $\tau(Y) - H$ and making no payment. To make late payment possible, assume that $H < \tau(Y)$. In addition to the monetary cost, payment also costs time, effort, and the psychological cost due to loss aversion, which total $\psi(\tau(Y) - H)$. After the deadline at time $t = 0$, failure to pay incurs expected sanctions $R_D^{max\{0,t\}}[\tau(Y) - H)] + S(t)$ from the tax authority, which include not only interest and penalties, but also utility costs of anxiety induced by both ever-sterner admonitions to pay and the possibility that assets will be subject to a lien, levy, or seizure. The taxpayer discounts the future quasi-hyperbolically with discount factor δ and additional discount factor β applied to periods after the present.

Taxpayers deciding when to pay trade off the additional costs of paying today rather than tomorrow against the additional benefits of paying today. The taxpayer pays at the first t such that

$$-\psi(R_D^{max\{0,t\}}[\tau(Y) - H)]) - R_D^{max\{0,t\}}[\tau(Y) - H)] \geq \tag{13}$$

$$-\beta\delta\Big[\psi(R_D^{max\{0,t+1\}}[\tau(Y) - H)]) + (1/R_S)R_D^{max\{0,t+1\}}[\tau(Y) - H)] + S(t)\Big]. \tag{14}$$

Absent procrastination and assuming that the return to saving is lower than R_D, taxpayer behavior is governed by intertemporal substitution given discount rate δ, leading many taxpayers to pay at the deadline, maximizing the time value of delay, and some taxpayers with high values of δ to pay late. Taxpayers are especially likely to pay at times when the expected sanctions for continued failure to pay increase.

Procrastination leads more taxpayers to pay after the deadline, and by driving a wedge between the utility function they use when making the payment decision, which discounts at rate $\beta\delta$, and the utility they ultimately experience, which discounts at rate δ, procrastination makes taxpayers whose behavior it changes worse off.

Withholding changes the relative costs of payment today and tomorrow. Differentiating the net benefit of payment today with respect to H gives

$$\psi'(R_D^{max\{0,t\}}[\tau(Y)-H)]) - \beta\delta\psi'(R_D^{max\{0,t+1\}}[\tau(Y)-H)]) + R_D^{max\{0,t\}} - \beta\delta(1/R_S)R_D^{max\{0,t+1\}}. \tag{15}$$

Assume $\psi'(\cdot)$ is constant. Then, before the deadline, withholding can make earlier payment more likely because it reduces the non-monetary costs of making payments - the effect of withholding on the net benefit of paying today is $\psi'(\cdot)[1-\beta\delta]+1-\beta\delta(1/R_S)$. Withholding also reduces the incentive to pay at the deadline to maximize interest. At the deadline, withholding's effect on the net benefit is $\psi'(\cdot)[1-\beta\delta]+1-\beta\delta(R_D/R_S)$, which again can induce payment on time through non-monetary costs of payment. Withholding could also induce later payment by reducing the interest cost of paying late. The effect of increasing withholding is potentially ambiguous for taxpayers who still owe payments, but the effect if withholding increases enough that no additional payment is due is unambiguous, preventing late payment altogether and removing the non-monetary cost ψ of making payments.

These models make different predictions about who pays late, which I test empirically. The liquidity constraint model implies that a change in withholding only affects taxpayers who do not save in liquid assets. The frictions model implies that withholding disproportionately affects taxpayers with high actual or perceived cost of time and effort before the deadline relative to after the deadline, who will be especially likely to make errors before the deadline along several dimensions of choice. It is also possible that some taxpayers are affected by both liquidity constraints and costs of making payments directly. These taxpayers would attenuate the predicted patterns of behavior across taxpayers, blurring the sharpness of the predictions the models make.

7 Empirics: Who Pays Late and Why

To determine *why* people pay late, I test conflicting predictions about *who* pays late. I test the liquidity-constraint explanation for late payment using heterogeneity in the effect of the 2009 policy change by liquidity, and the payment-friction explanation for late payment by examining the relationship between late payment and errors on tax returns. The estimated patterns of response support a friction-driven rather than liquidity-constraint explanation for late payments. The estimated effects are no smaller, and if anything are larger, among taxpayers earning interest income, a proxy for liquidity. Late payers are especially likely to make errors on their returns that leave money on the table or underreport verifiable income.

7.1 Heterogeneity Specification

I study which taxpayers are more responsive to treatment by interacting the coefficient on the time period-by-treatment interaction with a variable that captures heterogeneity before treatment, for example by whether the taxpayer earned at least $100 of interest income in tax year 2008, and also interact the per-period effects of the baseline coefficients with the measure of heterogeneity. The resulting specification is

$$y_{it} = \alpha_i + \sum_t \eta_t ERP_i * int_{i,2008} + \sum_t \gamma_t X_i * int_{i,2008} + \varepsilon_{it}. \tag{16}$$

The notation is the same as the main specification, but the coefficients of interest are now the difference-in-difference-in-difference coefficients on the interaction between Economic Recovery Payment receipt and interest income (or another measure of heterogeneity), η_t. These coefficients quantify the difference in treatment effects between those taxpayers for whom the measure of heterogeneity takes on a value of one and a value of zero. These interaction coefficients capture the difference between causal effects of treatment for subpopulations defined by e.g. interest income, not the causal effect of changes in interest income.

7.2 Reducing Withholding Causes Taxpayers Earning Interest Income to Pay Late

I test the theory that late payment is due to liquidity constraints by examining heterogeneous treatment responses across access to liquid assets. In a model in which taxpayers are fully rational, taxpayers choose to pay taxes late because the opportunity costs of paying taxes on time exceed the interest and penalties due on late tax payments, and only taxpayers who do not hold low-interest assets pay late in response to withholding changes. This prediction is not consistent with the results of interacting measures of available funds with treatment, in which taxpayers with available funds are no less likely to be affected by the withholding cut as taxpayers without available funds. Instead, the late payment response among taxpayers with interest income is slightly larger, which could be the result of higher hassle costs for higher-income taxpayers with more complex tax situations and higher opportunity costs of time.

Although the tax data do not include a direct measure of low-interest asset holdings at filing time, I construct a variety of proxies for assets from data on the tax return. I combine taxable and tax-exempt interest income, then create an indicator variable equal to one if total interest income is greater than $100 in 2008, which is my preferred proxy for

low-interest asset holdings. Given the low-interest environment at this time, earning $100 of 2008 interest income implies holding principal many times larger than the $250 withholding reduction. In alternate specifications reported in Tables A.4-A.7 in the appendix, I use alternative measures of interest income, including total interest income greater than $500, total interest income greater than zero, total interest income greater than zero in all tax years from 2005-2008, and taxable dividend income greater than $100. In no case is the effect significantly smaller among those with higher liquidity than among those without.

Taxpayers with interest income respond *more* strongly to treatment, which is inconsistent with the liquidity-constraint explanation for late payment and could instead be due to higher hassle costs for higher-income taxpayers with more complex tax situations or to higher costs of the time spent checking payment accuracy. A reduction in withholding makes taxpayers with interest income greater than $100 in 2008 even less likely to pay in full than those without by one percentage point, as reported in Table 6 and shown in Figure 6. Taxpayers with interest income leave an additional $20 of their balances due not paid in 2009, shown in Figure 7, while there is no significant difference in the percentage of the balance due underpaid by interest income, as shown in Figure 8. The parallel pre-trends assumption for this triple-difference specification is supported by the fact that there is no statistically significant effect in any pre-treatment year for the dollar value underpaid, but there are pre-treatment effects in some years for the fully paid indicator and the percentage of the balance due underpaid. The interaction coefficients in 2004 and 2007 for the fully paid indicator are positive and strongly statistically significant, although with magnitudes less than half the one-percentage-point decline in 2009.

7.3 Late Payers Make More Errors on Their Returns

The same taxpayers who pay late are more likely to make various errors on their tax returns, lending support to the notion that the mechanism behind late payment is a friction that leads taxpayers to err along multiple dimensions due, for example, to limited time, lack of information, inattention, or procrastination. I focus on relatively common errors related to the Making Work Pay payroll tax credit. Millions of taxpayers made such errors in 2009.

In both the treated and control groups, late payers were more likely to make some error related to the Making Work Pay credit, as Table 7 shows. In the control group, the difference is 11 percent of late payers with some error versus 6 percent of those who paid in full, while in the treated group the difference is 37 percent among those who paid late versus 10 percent of those who paid in full.

Many taxpayers did not claim the 2009 Making Work Pay credit despite the fact that the

credit of up to $800 could be claimed using a single page form and with information mostly reported elsewhere on the return[7]. Among the control group, 9 percent of those who did not pay on time did not claim the credit, while 5 percent of those who did pay on time did not claim the credit. Among the treated group, seven percent of those who paid late did not claim the credit, while five percent of those who paid on time did not claim.

Those taxpayers receiving an Economic Recovery Payment often do not indicate payment receipt when claiming the credit, a $250 error in their own favor. When IRS detected this error, it sent taxpayers either a smaller refund or a request for additional payment, which may lead to late payment. Among those who did not pay on time in the treated group, 19 percent did not correctly report their Economic Recovery Payment on their return, while two percent of those who paid on time in the treated group did not report the Economic Recovery Payment.

The higher error rates among taxpayers failing to pay on time are consistent with the notion that frictions such as lack of time, information, or attention make taxpayers more likely to make errors in general, and that late payment may be one result of these frictions.

8 Policy Implications

The results in this paper inform tax withholding policy, which is currently being reshaped to reflect changes in the 2017 Tax Cuts and Jobs Act. Evaluating withholding policy involves a trade-off between withholding too much tax from some taxpayers and too little tax from others. The current withholding tables do not have sufficient flexibility to withhold exactly for all taxpayers because they depend only on wages net of allowances and marital status. This paper suggests that on the margin there are more benefits than costs of withholding slightly more. The Tax Cuts and Jobs Act will reshuffle taxpayers' tax liability relative to past levels of withholding, which may lead more taxpayers to owe balances due and therefore to pay late. Consistent with this concern, the IRS is currently engaged in an outreach campaign encouraging taxpayers to adjust withholding, and has created a withholding calculator on its website.

Cutting withholding, holding tax liability constant, might appear to provide economic stimulus when it is needed without a cost in tax revenue. A 1992 withholding cut was meant to provide economic stimulus at no change in tax liability. Shapiro and Slemrod (1995) find that forty-three percent of consumers surveyed said that they would spend most of the income

[7]As the returns came in, in light of several million taxpayers not claiming the credit and the desire to distribute the credit as economic stimulus, the IRS decided to credit these taxpayers with the credit amount they would have received based on information elsewhere on their returns and administrative data on payment receipt.

this policy shifted forward from their refunds or balances due to their paychecks. The 1992 policy increased balances due, which this paper suggests led to both additional administrative costs and burdens on taxpayers. The 2009 stimulus, in contrast, aimed to reduce taxpayers' tax liability and withholding by the same amount, and increases in balances due like those I study were unintentional. Providing stimulus by reducing tax liability alongside withholding does not change the balances taxpayers owe at filing, avoiding administrative and taxpayer burdens at a cost in tax revenue.

My results are likely to generalize to other marginal changes in withholding. Sahm, Shapiro and Slemrod (2012) find that spending responses to stimulus policies are larger to one-time payments than increased paychecks, so one might expect that the withholding reduction via one-time payment could produce more liquidity-driven late payments than a withholding reduction implemented through increased paychecks. The Great Recession could also increase withholding's impact on late payments by tightening liquidity constraints. However, I do not find that liquidity constraints drove late payments after a 2009 policy change. Treated taxpayers who are on average older and mostly receive Social Security retirement benefits could be unusually vulnerable to frictions, but the impact is larger for treated taxpayers who instead received Supplemental Security Income or veterans' disability/survivorship benefits and are likely younger[8], perhaps because retirees have more time to devote to ensuring accurate payment. While I find that the effects of a marginal change in withholding are due to frictions rather than liquidity, larger increases in withholding would be more likely to result in binding liquidity constraints, so larger changes in withholding could work through a different mechanism.

9 Conclusion

I find that if employers withhold less tax, and people are therefore responsible for paying more tax directly, late payments rise. An interaction between two 2009 stimulus policies, a payroll tax credit and direct payments to retirement and disability beneficiaries, provides identifying variation in withholding. Using a difference-in-differences strategy, I show that late payments increase by an average of five percent of the amount of a withholding cut. In a sample that excludes people due a refund, who cannot pay late, the estimated effects are four times larger. By cutting withholding for more than 5.7 million households, the policy I study caused an additional 80,000 households to pay taxes late. Taxpayers whose withholding is cut by $250 are more likely to owe late taxes until one year later, when the following year's refunds provide the IRS with an opportunity to collect.

[8]See Table A.3.

While in theory liquidity constraints could explain late payment, I find instead that people pay late because making tax payments directly creates hassle costs or frictions. If people pay late because of liquidity constraints, then changing withholding should have less of an effect on taxpayers not subject to liquidity constraints, yet I find that taxpayers earning interest income respond at least as much to a change in withholding, contrary to the liquidity constraint explanation. Frictions including procrastination and limited time or attention would suggest that people who pay late also make more concurrent errors. I find that people who pay late are more likely to file incorrect tax returns, either leaving a tax credit on the table or not reporting government-provided income.

On the margin, increased withholding has two substantial benefits. Greater withholding reduces the number of taxpayers who pay late, saving the administrative costs incurred to collect the taxes they owe. Withholding also reduces the costs taxpayers bear when responsible for making tax payments, whether due to hassle costs or frictions.

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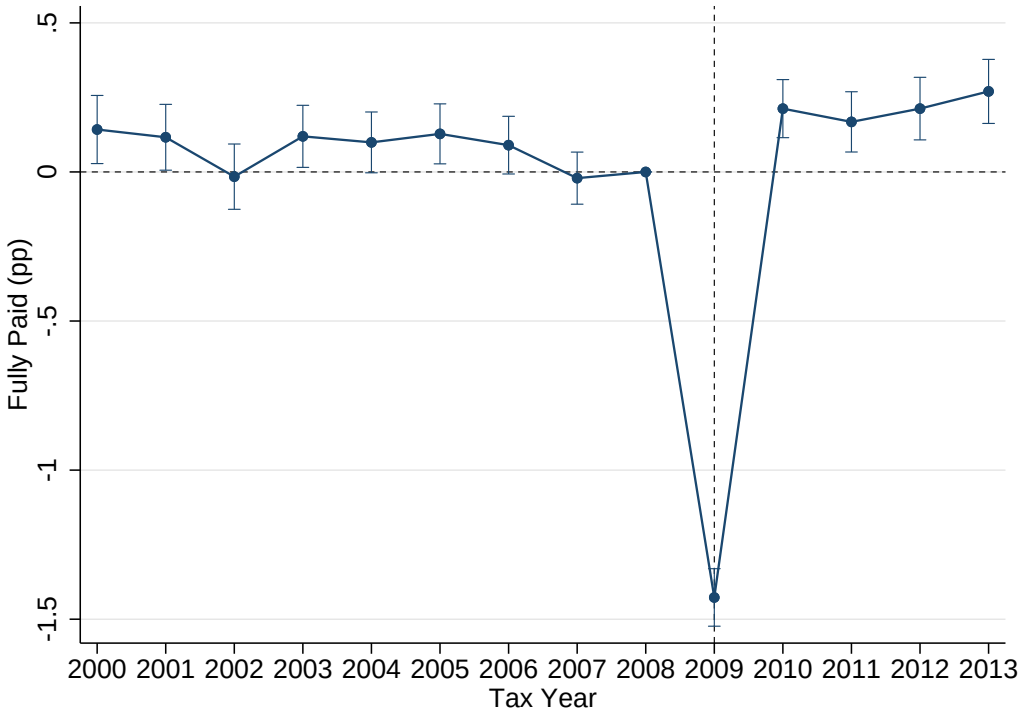
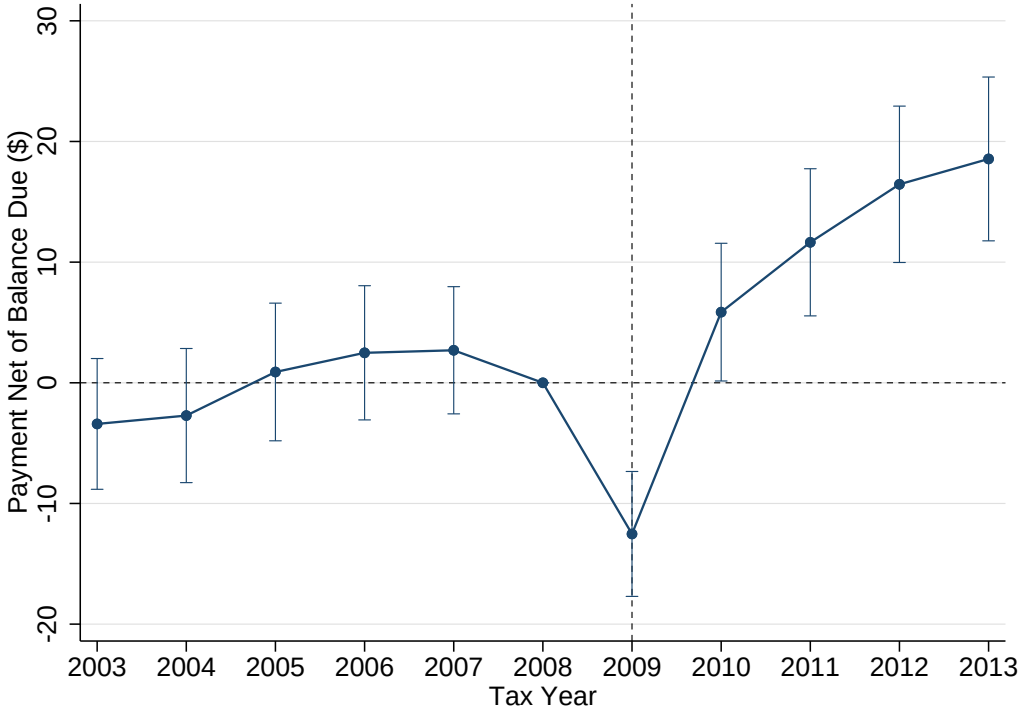
Figure 1: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Probability Fully Paid (Percentage Points)



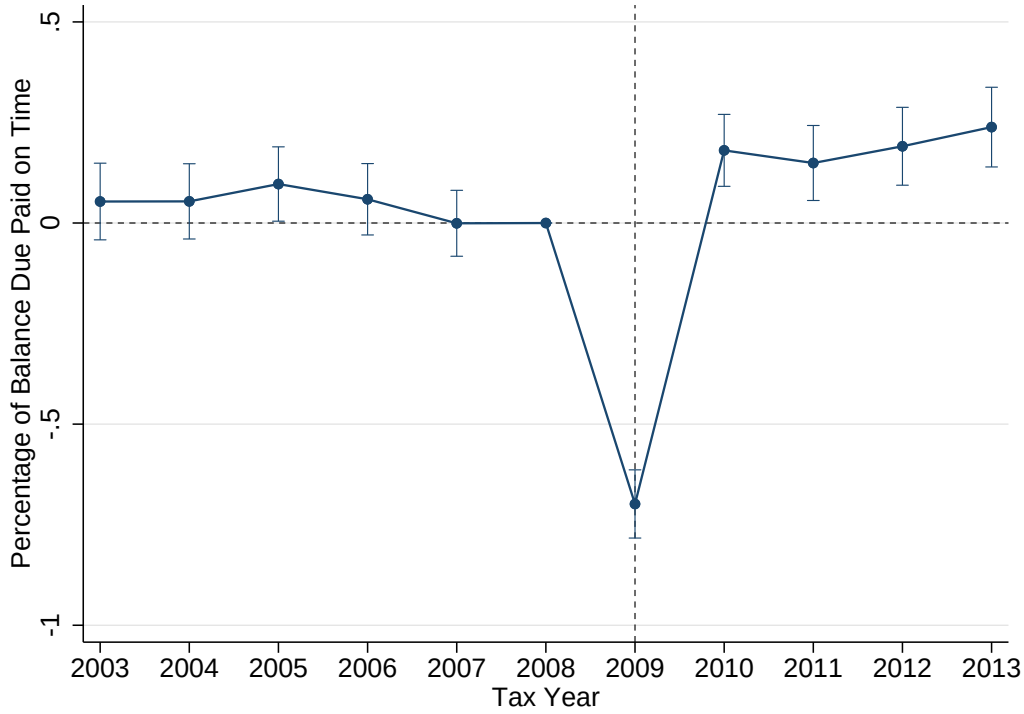
Notes: Outcome is an indicator for paying the full balance due with a return. Plots coefficients and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects and interactions between year fixed effects and 2008 age, marital status, spouse's age, and dependents.

Figure 2: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Payment Net of Balance Due ($)



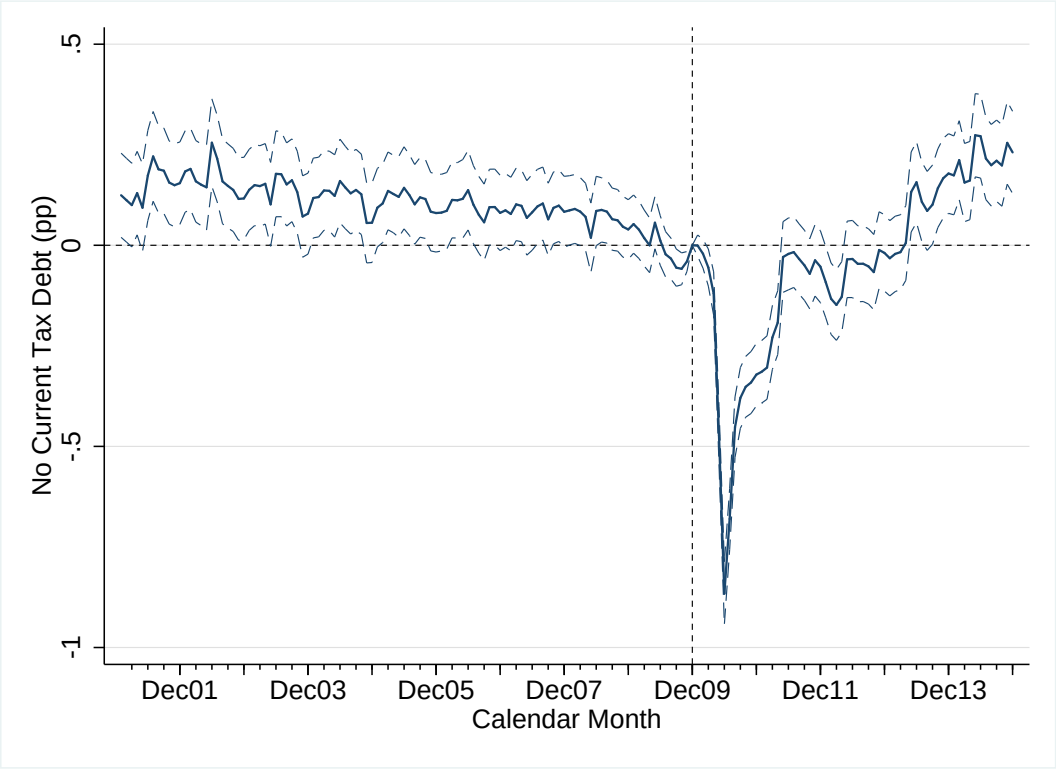
Notes: Outcome is the dollar amount paid with a return minus the balance due. Plots coefficients and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects and interactions between year fixed effects and 2008 age, marital status, spouse's age, and dependents.

Figure 3: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Percentage of Balance Due Paid



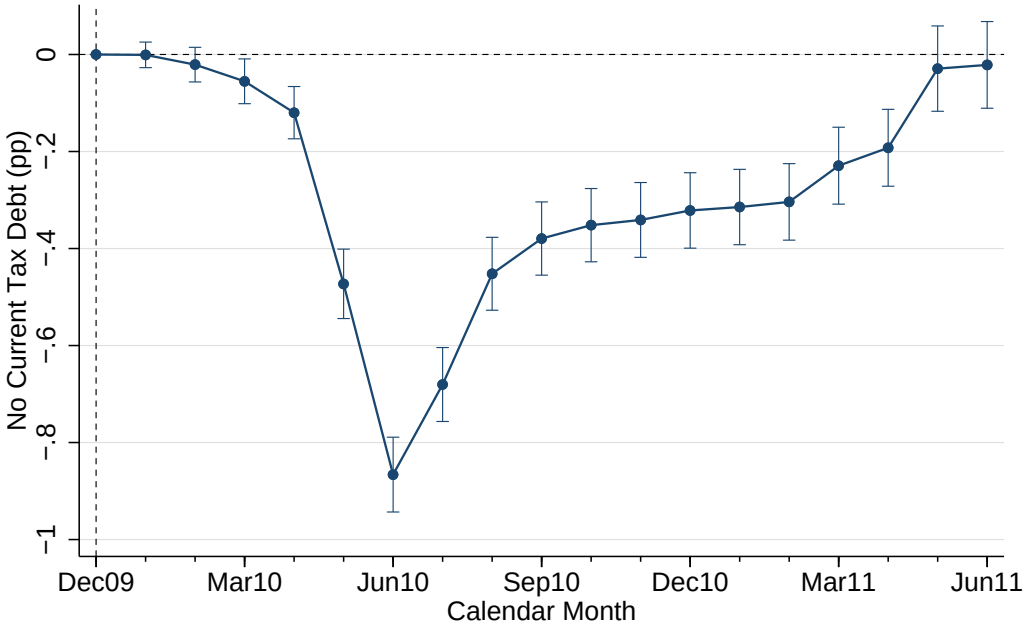
Notes: Outcome is the percentage of the balance due paid with the return. Plots coefficients and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects and interactions between year fixed effects and 2008 age, marital status, spouse's age, and dependents.

Figure 4: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Probability of No Current Tax Debt (Percentage Points)



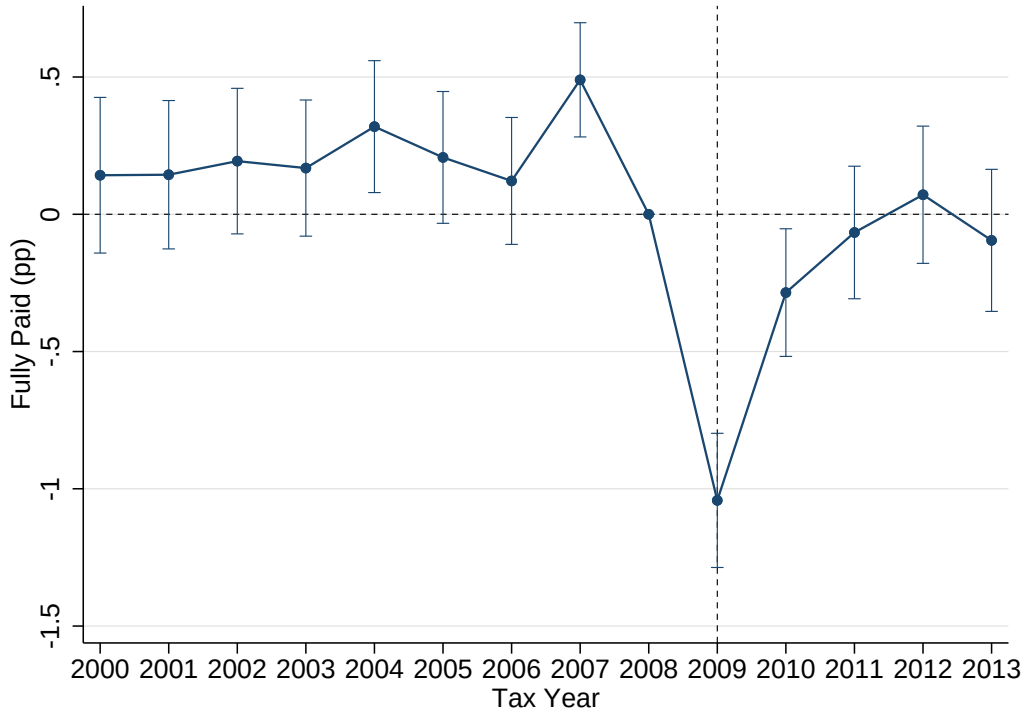
Notes: Outcome is an indicator for owing no current unpaid assessed tax. Plots coefficients and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects, interactions between time fixed effects and 2008 age, marital status, spouse's age, and dependents, and treatment-by-month-of-year fixed effects estimated from the pre-treatment period.

Figure 5: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Probability of No Current Tax Debt (Percentage Points), Detail



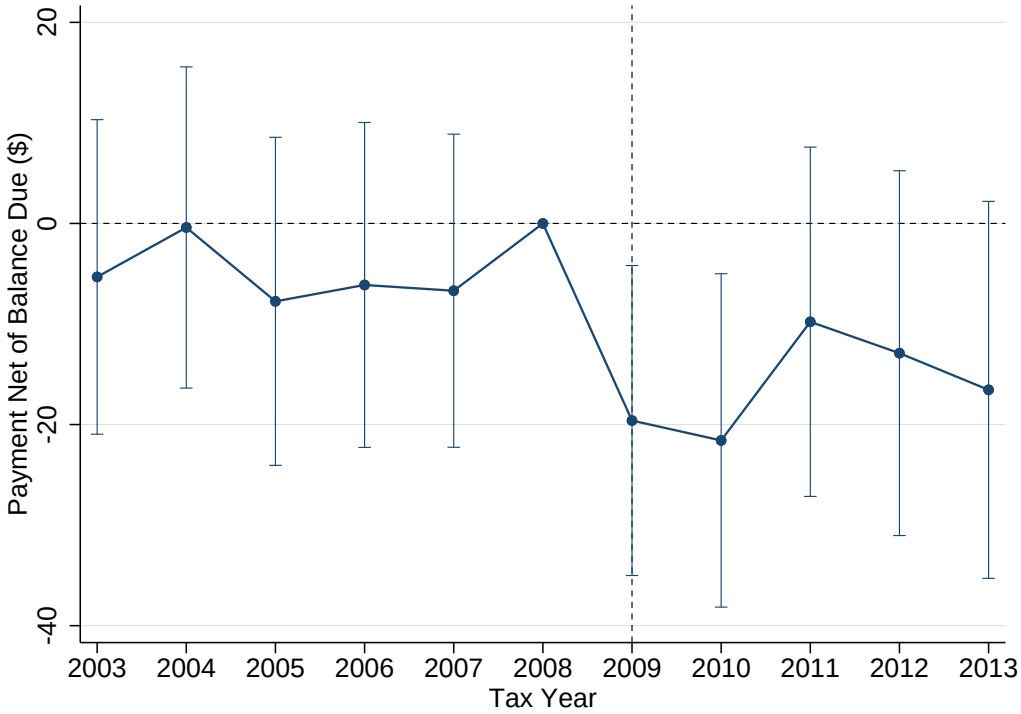
Notes: Outcome is an indicator for owing no current unpaid assessed tax. Plots coefficients and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects, interactions between time fixed effects and 2008 age, marital status, spouse's age, and dependents, and treatment-by-month-of-year fixed effects estimated from the pre-treatment period.

Figure 6: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Probability Fully Paid (Percentage Points): Coefficient on Interaction with Interest Income Greater Than $100 in 2008



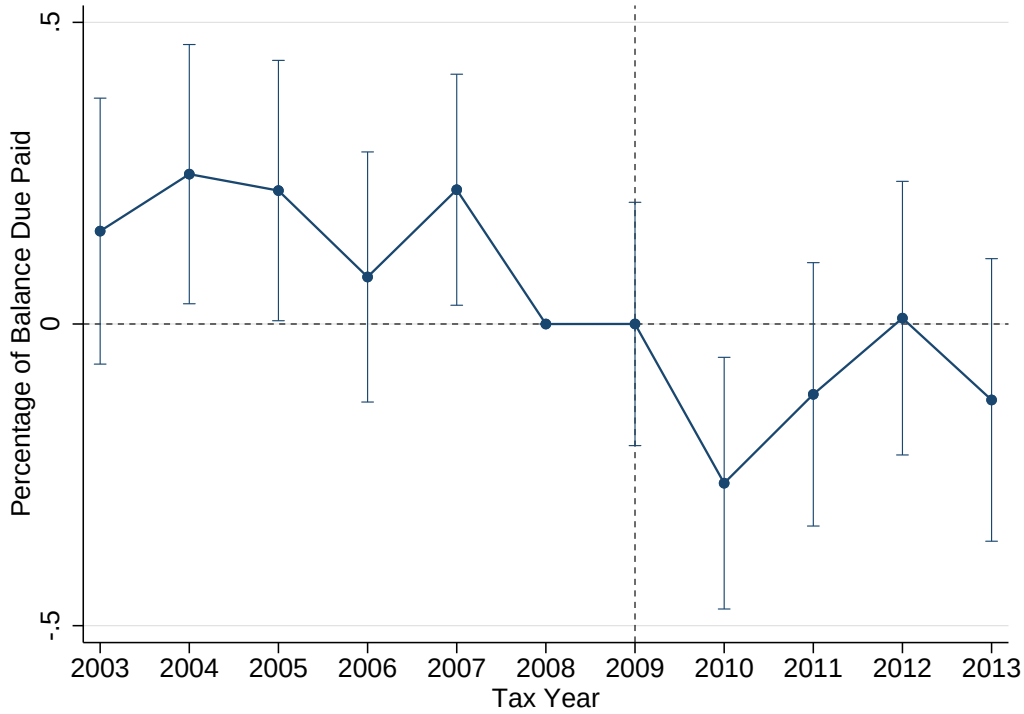
Notes: Outcome is an indicator for paying the full amount due with a return. Plots the interaction coefficients between treatment, the interest income indicator, and tax year, and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects, interactions between time fixed effects, the interest income indicator and 2008 age, marital status, spouse's age, and dependents, and treatment-by-month-of-year fixed effects estimated from the pre-treatment period.

Figure 7: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Payment Net of Balance Due ($): Coefficient on Interaction with Interest Income Greater Than $100 in 2008



Notes: Outcome is the dollar amount paid with a return minus the balance due. Plots the interaction coefficients between treatment, the interest income indicator, and tax year, and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects, interactions between time fixed effects, the interest income indicator and 2008 age, marital status, spouse's age, and dependents.

Figure 8: Difference-in-Difference Estimate of Effect of Reducing Withholding by $250 on Percentage of Balance Due Paid: Coefficient on Interaction with Interest Income Greater Than $100 in 2008



Notes: Outcome is the percentage of the balance due paid with the return. Plots the interaction coefficients between treatment, the interest income indicator, and tax year, and 95% confidence intervals (where standard errors are clustered at the taxpayer level) from a regression with taxpayer fixed effects, interactions between time fixed effects, the interest income indicator and 2008 age, marital status, spouse's age, and dependents.

Table 1: Summary Statistics before Treatment by Treatment Group

	Control	Treated
Single Filer (pp)	37.0	29.0
Married Filing Jointly (pp)	59.1	68.8
Age	46.20	58.04
Dependents Claimed	0.833	0.361
Wages ($)	59,047	41,265
Adjusted Gross Income ($)	67,802	60,763
Social Security (pp)	0.249	67.1
Total Interest Income ($)	832.7	1437.9
Positive Total Interest Income (pp)	50.5	58.3
Refund (pp)	84.0	77.0
Balance Due (Refund if Negative) ($)	-1,953.0	-1,187.6
Fully Paid on Time (pp)	95.52	95.41
Filed on Time (pp)	95.20	96.37
Payment Net of Balance Due ($)	-132.9	-119.0
Percentage of Balance Due Paid	95.95	96.01
Balance Due if Positive ($)	2,562.1	2,306.3
Refund if Positive ($)	2,874.5	2,304.5
Full Paid (pp) if Balance Due	72.28	80.12
Payment Net of Balance Due ($) if Balance Due	-822.8	-515.6
Random Sample Size	1%	10%
N	478,923	567,778

Means reported. (pp) indicates percentage points. Tax year 2008 variables unless otherwise indicated. Treated and control groups have 2008 wages between $4033 and $82,500 ($177,500 if married filing jointly) that would, if earned in 2009, qualify for a Making Work Pay payroll tax credit of at least $250. Treated units received exactly one Economic Recovery Payment of $250 in April or May 2009; control units did not. This payment reduced the treated group's credit by up to $250, close to the observed 2009 difference of $194. The difference is due to 2008-2009 wage changes and because the credit's definition of earned income differs somewhat from wages. Treatment groups are determined on the basis of 2008 wages because 2009 wages may respond to the policy change. Most treated units receive either exactly the maximum possible single credit of $150 or joint credit of $550, reduced by $250 from $400 ($800). As both groups received a withholding reduction in line with the full credit, this implies that the policies resulted in larger 2009 balances due (or smaller refunds) for the treated group than otherwise. I restrict to households in which tax filer(s) are between 30 and 70 years of age in 2008 and the primary filer is not deceased. Single and married filing jointly indicators do not add to one because some taxpayers are either married filing separately or filing as head of household. Dependents claimed are non-spouse dependents under age 25. Dollar amounts are winsorized at the 1st and 99th percentiles.

Table 2: Making Work Pay Tax Credits by Treated Group

	Control	Treated
2009 Making Work Pay Credit ($)	545.9	351.2
Exactly $150 of 2009 Making Work Pay Credit (pp)	0.282	16.0
Exactly $550 of 2009 Making Work Pay Credit (pp)	0.164	47.3
Random Sample Size	1%	10%
Households	483,291	577,901

Means reported. Treated and control groups have 2008 wages between $4033 and $82,500 ($177,500 if married filing jointly) that would, if earned in 2009, qualify for a Making Work Pay payroll tax credit of at least $250. Treated units received exactly one Economic Recovery Payment of $250 in April or May 2009; control units did not. This payment reduced the treated group's credit by up to $250, close to the observed 2009 difference of $194. The difference is due to 2008-2009 wage changes and because the credit's definition of earned income differs slightly from wages. Treatment groups are determined on the basis of 2008 wages because 2009 wages may respond to the policy change. Most treated units receive either exactly the maximum possible single credit of $150 or joint credit of $550, reduced by $250 from $400 ($800). As both groups received a withholding reduction in line with the full credit, this implies that the policies resulted in larger 2009 balances due (or smaller refunds) for the treated group than otherwise. I restrict to households in which tax filer(s) are between 30 and 70 years of age in 2008 and the primary filer is not deceased.

Table 3: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated	0.142**		
	(0.0583)		
2001 * Treated	0.116**		
	(0.0563)		
2002 * Treated	-0.0158		
	(0.0559)		
2003 * Treated	0.119**	-3.407	0.0535
	(0.0531)	(2.765)	(0.0486)
2004 * Treated	0.0991*	-2.716	0.0538
	(0.0520)	(2.836)	(0.0477)
2005 * Treated	0.128**	0.897	0.0970**
	(0.0513)	(2.911)	(0.0472)
2006 * Treated	0.0899*	2.486	0.0591
	(0.0493)	(2.837)	(0.0453)
2007 * Treated	-0.0208	2.697	-0.000642
	(0.0446)	(2.689)	(0.0418)
2008 * Treated	(omitted)	(omitted)	(omitted)
2009 * Treated	-1.427***	-12.53***	-0.698***
	(0.0492)	(2.641)	(0.0432)
2010 * Treated	0.212***	5.856**	0.181***
	(0.0497)	(2.911)	(0.0456)
2011 * Treated	0.168***	11.64***	0.149***
	(0.0516)	(3.111)	(0.0476)
2012 * Treated	0.212***	16.45***	0.191***
	(0.0535)	(3.306)	(0.0494)
2013 * Treated	0.270***	18.55***	0.238***
	(0.0548)	(3.463)	(0.0505)
F-stat Pre-2008	3.278	1.649	1.202
p-value Pre-2008	<0.0001	0.143	0.305
F-stat Post-2008	301.6	23.68	112.6
p-value Post-2008	<0.0001	<0.0001	<0.0001
Household FE	Yes	Yes	Yes
Year FE *Demographics	Yes	Yes	Yes
Years	14	11	11
Household-Years	13,782,245	10,904,992	10,904,992
R-Squared	0.000142	0.0000186	0.0000712

Notes: standard errors (in parentheses) clustered by household. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Includes interactions between year fixed effects and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table 4: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction Conditional on Owing a Balance Due.

	(1) Full Paid (pp) if Balance Due	(2) Payment Net of Balance Due ($) if Balance Due
2000 * Treated	-0.395**	
	(0.193)	
2001 * Treated	-0.633***	
	(0.198)	
2002 * Treated	-0.855***	
	(0.195)	
2003 * Treated	-0.433**	-14.88
	(0.199)	(14.37)
2004 * Treated	-0.605***	-23.80*
	(0.185)	(13.61)
2005 * Treated	-0.247	-14.90
	(0.184)	(13.79)
2006 * Treated	-0.407**	-14.18
	(0.180)	(13.59)
2007 * Treated	0.0225	-8.327
	(0.172)	(12.94)
2008 * Treated	(omitted)	(omitted)
2009 * Treated	-5.647***	-49.76***
	(0.188)	(13.44)
2010 * Treated	-0.216	-17.30
	(0.181)	(13.88)
2011 * Treated	-0.105	1.752
	(0.180)	(14.25)
2012 * Treated	-0.157	2.849
	(0.179)	(14.28)
2013 * Treated	-0.00653	4.505
	(0.180)	(14.68)
F-stat Pre-2008	4.874	0.651
p-value Pre-2008	<0.001	0.661
F-stat Post-2008	276.9	4.482
p-value Post-2008	<0.001	<0.001
Tax Unit Fixed Effects	Yes	Yes
Year FE * Demographics	Yes	Yes
Years	14	11
Tax Unit-Years	2729742	2118187
R-Squared	0.000647	0.0000153

Notes: standard errors (in parentheses) clustered by household. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Includes interactions between year fixed effects and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table 5: Difference-in-Difference Estimates of Effect of $250 Withholding Reduction on Monthly Tax Debt Status.

Calendar Month	No Current Tax Debt (pp)
December 2009 * Treated	(omitted)
January 2010 * Treated	-0.000782
	(0.0135)
February 2010 * Treated	-0.0209
	(0.0182)
March 2010 * Treated	-0.0553**
	(0.0236)
April 2010 * Treated	-0.120***
	(0.0275)
May 2010 * Treated	-0.473***
	(0.0365)
June 2010 * Treated	-0.866***
	(0.0393)
July 2010 * Treated	-0.680***
	(0.0389)
August 2010 * Treated	-0.452***
	(0.0383)
September 2010 * Treated	-0.379***
	(0.0385)
October 2010 * Treated	-0.352***
	(0.0385)
November 2010 * Treated	-0.341***
	(0.0393)
December 2010 * Treated	-0.322***
	(0.0397)
January 2011 * Treated	-0.314***
	(0.0396)
February 2011 * Treated	-0.304***
	(0.0402)
March 2011 * Treated	-0.229***
	(0.0405)
April 2011 * Treated	-0.192***
	(0.0404)
May 2011 * Treated	-0.0291
	(0.0449)
Household Fixed Effects	Yes
Month Fixed Effects * Demographics	Yes
Month-of-Year Fixed Effects * Treated Indicator	Yes
Months	168
Household-Months	232,753,860
R-Squared	0.0000262

Notes: standard errors (in parentheses) clustered by household. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Tax year 2009 returns are due from January-April 2010. Specificaion removes seasonality with treatment * calendar month fixed effects estimated from the pre-2010 period and interacts month FE with 2008 age fixed effects, marital status, spouse's age, and dependents.

Table 6: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Coefficients on Interaction with 2008 Interest Income Greater than $100 Indicator

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated * Interest Income	0.142		
	(0.145)		
2001 * Treated * Interest Income	0.144		
	(0.138)		
2002 * Treated * Interest Income	0.194		
	(0.135)		
2003 * Treated * Interest Income	0.168	-5.319	0.154
	(0.127)	(7.981)	(0.112)
2004 * Treated * Interest Income	0.319***	-0.401	0.248**
	(0.123)	(8.149)	(0.110)
2005 * Treated * Interest Income	0.207*	-7.745	0.221**
	(0.122)	(8.322)	(0.110)
2006 * Treated * Interest Income	0.121	-6.116	0.0780
	(0.118)	(8.243)	(0.106)
2007 * Treated * Interest Income	0.490***	-6.690	0.223**
	(0.106)	(7.943)	(0.0977)
2008 * Treated * Interest Income	(omitted)	(omitted)	(omitted)
2009 * Treated * Interest Income	-1.04***	-19.60**	0.0000775
	(0.125)	(7.864)	(0.103)
2010 * Treated * Interest Income	-0.285**	-21.58**	-0.264**
	(0.119)	(8.457)	(0.106)
2011 * Treated * Interest Income	-0.0663	-9.779	-0.117
	(0.123)	(8.861)	(0.111)
2012 * Treated * Interest Income	0.0711	-12.90	0.00971
	(0.128)	(9.254)	(0.116)
2013 * Treated * Interest Income	-0.0951	-16.55*	-0.126
	(0.132)	(9.564)	(0.119)
F-stat Pre-2008	3.544	0.414	1.813
p-value Pre-2008	0.000412	0.839	0.106
F-stat Post-2008	18.13	1.827	2.095
p-value Post-2008	<0.0001	0.104	0.0629
Household Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	14	14
Household-Years	13,327,835	10,703,607	10,703,607
R-Squared	0.00283	0.00109	0.00189

Notes: standard errors (in parentheses) clustered by tax unit. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Interest income includes both taxable and tax-exempt interest. Includes interactions between year fixed effects, interest indicator, and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table 7: Errors in Claiming and Calculating Making Work Pay Credit by Treatment Group and Whether Fully Paid in 2009

	Control, Not Fully Paid	Control, Fully Paid	Treated, Not Fully Paid	Treated, Fully Paid
Made any error related to credit (pp)	10.9	6.29	37.3	9.69
Did not claim credit(pp) (IRS filed ex post)	9.19	5.44	6.97	5.37
Claimed credit, but did not report Economic Recovery Payment (pp)	N/A	N/A	18.6	1.89
Random Sample Size	1%	1%	10%	10%
N	22,705	460,586	39,008	538,893

Table A.1: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Married Filing Jointly Subsample.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated	0.00761		
	(0.0711)		
2001 * Treated	-0.0215		
	(0.0682)		
2002 * Treated	-0.191***		
	(0.0676)		
2003 * Treated	-0.0131	-12.10***	-0.0894
	(0.0640)	(3.870)	(0.0575)
2004 * Treated	-0.106*	-11.02***	-0.134**
	(0.0625)	(3.966)	(0.0563)
2005 * Treated	-0.0158	-4.831	-0.0376
	(0.0618)	(4.081)	(0.0559)
2006 * Treated	-0.0436	-3.441	-0.0729
	(0.0595)	(4.008)	(0.0538)
2007 * Treated	-0.172***	-1.461	-0.108**
	(0.0540)	(3.839)	(0.0500)
2008 * Treated	(omitted)	(omitted)	(omitted)
2009 * Treated	-1.677***	-16.80***	-0.766***
	(0.0599)	(3.765)	(0.0516)
2010 * Treated	0.0851	2.893	0.0591
	(0.0604)	(4.142)	(0.0547)
2011 * Treated	-0.0721	8.382*	-0.0732
	(0.0631)	(4.417)	(0.0575)
2012 * Treated	-0.0476	11.87**	-0.0442
	(0.0656)	(4.650)	(0.0599)
2013 * Treated	0.0180	14.53***	-0.00545
	(0.0670)	(4.837)	(0.0612)
F-stat Pre-2008	3.548	3.023	1.755
p-value Pre-2008	0.000407	0.00988	0.118
F-stat Post-2008	234.9	12.39	68.40
p-value Post-2008	<0.0001	<0.0001	<0.0001
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	9200603	7243010	7243010
R-Squared	0.000150	0.0000181	0.0000536

Notes: standard errors (in parentheses) clustered by household. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Includes interactions between year fixed effects and 2008 age fixed effects, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table A.2: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Subsample with Fewer Than Three Dependents in 2008

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated	0.154**		
	(0.0609)		
2001 * Treated	0.141**		
	(0.0589)		
2002 * Treated	0.00841		
	(0.0585)		
2003 * Treated	0.132**	-2.098	0.0653
	(0.0556)	(2.819)	(0.0509)
2004 * Treated	0.129**	-1.061	0.0783
	(0.0546)	(2.897)	(0.0501)
2005 * Treated	0.148***	1.685	0.111**
	(0.0539)	(2.970)	(0.0495)
2006 * Treated	0.0938*	2.445	0.0594
	(0.0517)	(2.892)	(0.0475)
2007 * Treated	-0.00738	2.433	-0.000388
	(0.0468)	(2.728)	(0.0439)
2008 * Treated	(omitted)	(omitted)	(omitted)
2009 * Treated	-1.456***	-11.26***	-0.711***
	(0.0513)	(2.692)	(0.0453)
2010 * Treated	0.242***	6.880**	0.206***
	(0.0519)	(2.950)	(0.0477)
2011 * Treated	0.195***	10.95***	0.174***
	(0.0538)	(3.151)	(0.0497)
2012 * Treated	0.235***	15.57***	0.210***
	(0.0557)	(3.349)	(0.0515)
2013 * Treated	0.329***	19.14***	0.288***
	(0.0570)	(3.514)	(0.0526)
F-stat Pre-2008	3.096	0.919	1.421
p-value Pre-2008	0.00170	0.468	0.213
F-stat Post-2008	298.2	21.09	112.6
p-value Post-2008	<0.001	<0.001	<0.001
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	12,916,840	10,219,254	10,219,254
R-Squared	0.000149	0.0000174	0.0000768

Notes: standard errors (in parentheses) clustered by household. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Includes interactions between year fixed effects and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table A.3: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Subsample without Social Security Income in 2008.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated	0.0520		
	(0.0830)		
2001 * Treated	-0.0310		
	(0.0804)		
2002 * Treated	-0.385***		
	(0.0805)		
2003 * Treated	-0.0718	-3.995	-0.125*
	(0.0761)	(3.659)	(0.0704)
2004 * Treated	-0.0694	-6.151	-0.101
	(0.0745)	(3.800)	(0.0691)
2005 * Treated	-0.102	-3.343	-0.125*
	(0.0731)	(3.888)	(0.0678)
2006 * Treated	-0.133*	-2.047	-0.161**
	(0.0701)	(3.795)	(0.0650)
2007 * Treated	-0.202***	-2.505	-0.179***
	(0.0631)	(3.560)	(0.0599)
2008 * Treated	(omitted)	(omitted)	(omitted)
2009 * Treated	-3.325***	-38.52***	-1.704***
	(0.0768)	(3.607)	(0.0652)
2010 * Treated	-0.271***	-10.32***	-0.235***
	(0.0723)	(3.989)	(0.0670)
2011 * Treated	-0.0678	2.246	-0.0664
	(0.0747)	(4.227)	(0.0696)
2012 * Treated	0.0636	9.487**	0.0620
	(0.0776)	(4.529)	(0.0722)
2013 * Treated	0.216***	12.88***	0.185**
	(0.0795)	(4.686)	(0.0739)
F-stat Pre-2008	5.989	0.569	2.045
p-value Pre-2008	<0.0001	0.724	0.0691
F-stat Post-2008	491.0	37.89	188.2
p-value Post-2008	<0.0001	<0.0001	<0.0001
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	8,765,752	6,935,877	6,935,877
R-Squared	0.000474	0.0000307	0.000200

Notes: standard errors (in parentheses) clustered by household. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Includes interactions between year fixed effects and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table A.4: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Heterogeneity by Interest Income over $500 in 2008.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated * Interest	0.155		
	(0.162)		
2001 * Treated * Interest	0.189		
	(0.153)		
2002 * Treated * Interest	0.183		
	(0.150)		
2003 * Treated * Interest	0.212	-8.788	0.150
	(0.139)	(9.978)	(0.119)
2004 * Treated * Interest	0.214	-16.20	0.126
	(0.136)	(10.19)	(0.117)
2005 * Treated * Interest	0.0356	-18.15*	0.0534
	(0.138)	(10.68)	(0.120)
2006 * Treated * Interest	0.0342	-18.51*	-0.0629
	(0.134)	(10.70)	(0.116)
2007 * Treated * Interest	0.452***	-4.948	0.219**
	(0.120)	(10.39)	(0.107)
2008 * Treated * Interest	(omitted)	(omitted)	(omitted)
2009 * Treated * Interest	-0.925***	-33.17***	0.0739
	(0.144)	(9.915)	(0.112)
2010 * Treated * Interest	-0.139	-34.29***	-0.156
	(0.130)	(10.87)	(0.113)
2011 * Treated * Interest	0.0392	-18.74*	-0.0337
	(0.135)	(11.17)	(0.119)
2012 * Treated * Interest	0.0369	-24.69**	-0.0644
	(0.141)	(11.52)	(0.124)
2013 * Treated * Interest	0.0517	-12.54	-0.0132
	(0.144)	(11.83)	(0.127)
F-stat Pre-2008	2.757	1.024	1.811
p-value Pre-2008	0.00482	0.401	0.107
F-stat Post-2008	11.49	3.084	0.914
p-value Post-2008	<0.0001	0.00872	0.471
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	13,327,835	10,703,607	10,703,607
R-Squared	0.00277	0.00114	0.00183

Notes: standard errors (in parentheses) clustered by tax unit. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Interest income includes both taxable and tax-exempt interest. Includes interactions between year fixed effects, interest indicator, and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table A.5: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Heterogeneity by Positive 2008 Interest Income.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated * Interest	0.288*		
	(0.155)		
2001 * Treated * Interest	0.420***		
	(0.148)		
2002 * Treated * Interest	0.177		
	(0.146)		
2003 * Treated * Interest	0.416***	-5.375	0.361***
	(0.138)	(6.994)	(0.127)
2004 * Treated * Interest	0.382***	-0.928	0.356***
	(0.134)	(7.116)	(0.124)
2005 * Treated * Interest	0.315**	-2.642	0.329***
	(0.131)	(7.184)	(0.121)
2006 * Treated * Interest	0.395***	3.763	0.326***
	(0.125)	(6.996)	(0.116)
2007 * Treated * Interest	0.713***	1.048	0.307***
	(0.112)	(6.520)	(0.106)
2008 * Treated * Interest	(omitted)	(omitted)	(omitted)
2009 * Treated * Interest	-1.123***	-16.14**	-0.114
	(0.124)	(6.618)	(0.110)
2010 * Treated * Interest	-0.381***	-14.68**	-0.395***
	(0.126)	(7.244)	(0.117)
2011 * Treated * Interest	-0.142	-14.09*	-0.200
	(0.132)	(7.616)	(0.123)
2012 * Treated * Interest	-0.0525	-8.404	-0.0615
	(0.138)	(8.097)	(0.128)
2013 * Treated * Interest	0.0407	-11.73	-0.00418
	(0.142)	(8.572)	(0.133)
F-stat Pre-2008	5.845	0.435	2.608
p-value Pre-2008	<0.0001	0.824	0.0230
F-stat Post-2008	20.49	1.456	3.047
p-value Post-2008	<0.0001	0.201	0.00941
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	13,327,835	10,703,607	10,703,607
R-Squared	0.00292	0.00107	0.00203

Notes: standard errors (in parentheses) clustered by tax unit. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Interest income includes both taxable and tax-exempt interest. Includes interactions between year fixed effects, interest indicator, and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table A.6: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Heterogeneity by Positive Interest Income in All Years 2005-2008.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated * Interest	0.212		
	(0.145)		
2001 * Treated * Interest	0.350**		
	(0.138)		
2002 * Treated * Interest	0.0966		
	(0.136)		
2003 * Treated * Interest	0.206	-13.50*	0.220*
	(0.128)	(7.278)	(0.115)
2004 * Treated * Interest	0.250**	-5.477	0.210*
	(0.124)	(7.454)	(0.112)
2005 * Treated * Interest	0.208*	-7.566	0.206*
	(0.123)	(7.556)	(0.111)
2006 * Treated * Interest	0.390***	-0.498	0.338***
	(0.119)	(7.454)	(0.108)
2007 * Treated * Interest	0.585***	-8.862	0.298***
	(0.107)	(7.103)	(0.0998)
2008 * Treated * Interest	(omitted)	(omitted)	(omitted)
2009 * Treated * Interest	-1.177***	-19.66***	-0.141
	(0.126)	(7.258)	(0.107)
2010 * Treated * Interest	-0.521***	-33.46***	-0.531***
	(0.122)	(7.899)	(0.111)
2011 * Treated * Interest	-0.259**	-26.45***	-0.310***
	(0.127)	(8.213)	(0.116)
2012 * Treated * Interest	-0.161	-24.47***	-0.172
	(0.132)	(8.671)	(0.121)
2013 * Treated * Interest	-0.244*	-30.63***	-0.272**
	(0.136)	(9.093)	(0.125)
F-stat Pre-2008	4.810	1.241	2.459
p-value Pre-2008	0.00000615	0.287	0.0309
F-stat Post-2008	19.47	4.233	5.190
p-value Post-2008	<0.0001	0.000754	<0.0001
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	12,800,881	10,184,534	10,184,534
R-Squared	0.00303	0.00111	0.00204

Notes: standard errors (in parentheses) clustered by tax unit. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Interest income includes both taxable and tax-exempt interest. Includes interactions between year fixed effects, interest indicator, and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.

Table A.7: Difference-in-Difference Estimates of Effects of $250 Withholding Reduction: Heterogeneity by Dividend Income over $100 in 2008.

	(1) Fully Paid (pp)	(2) Payment Net of Balance Due ($)	(3) Percentage of Balance Due Paid
2000 * Treated * Dividends	0.303*		
	(0.169)		
2001 * Treated * Dividends	0.222		
	(0.156)		
2002 * Treated * Dividends	-0.0121		
	(0.152)		
2003 * Treated * Dividends	-0.0347	1.051	0.0670
	(0.143)	(9.830)	(0.121)
2004 * Treated * Dividends	-0.0396	-0.496	0.0128
	(0.139)	(10.11)	(0.120)
2005 * Treated * Dividends	-0.0124	-7.701	0.0416
	(0.141)	(10.12)	(0.123)
2006 * Treated * Dividends	0.133	-8.011	0.114
	(0.137)	(10.01)	(0.119)
2007 * Treated * Dividends	0.216*	-7.685	0.0439
	(0.123)	(9.687)	(0.110)
2008 * Treated * Dividends	(omitted)	(omitted)	(omitted)
2009 * Treated * Dividends	-1.022***	-6.986	0.0289
	(0.150)	(9.868)	(0.116)
2010 * Treated * Dividends	-0.257*	-14.83	-0.284**
	(0.136)	(10.87)	(0.118)
2011 * Treated * Dividends	-0.192	-12.14	-0.176
	(0.140)	(11.29)	(0.123)
2012 * Treated * Dividends	-0.129	-11.40	-0.0919
	(0.145)	(11.67)	(0.129)
2013 * Treated * Dividends	-0.119	-6.943	-0.101
	(0.149)	(12.01)	(0.132)
F-stat Pre-2008	1.501	0.383	0.248
p-value Pre-2008	0.151	0.861	0.941
F-stat Post-2008	10.32	0.435	1.817
p-value Post-2008	<0.0001	0.825	0.106
Tax Unit Fixed Effects	Yes	Yes	Yes
Year FE * Demographics	Yes	Yes	Yes
Years	14	11	11
Tax Unit-Years	13,327,835	10,703,607	10,703,607
R-Squared	0.00275	0.00108	0.00181

Notes: standard errors (in parentheses) clustered by tax unit. * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$. Dividend income is taxable dividend income. Includes interactions between year fixed effects, interest indicator, and 2008 age fixed effects, marital status, spouse's age, and dependents. Payment amount data begin in 2003. Payment net of balance due winsorized at the 1st and 99th percentiles. F-statistics report joint statistical significance of all pre-2008 or post-2008 coefficients.