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Bunching to Maximize Tax Credits: Evidence from Kinks in the US Tax Schedule†

By Jacob A. Mortenson and Andrew Whitten*

We explore bunching at US income tax kinks using a panel of 258 million tax returns from 1996 to 2014. We find bunching at seven kinks, with nearly all bunching occurring at kinks maximizing tax credits. In our sample period, the total number of bunchers increased at an 11 percent annualized growth rate, from 134,300 in 1996 to 866,600 in 2014. Approximately two-thirds of these bunchers locate at the unique point that maximizes refunds. Some taxpayers repeatedly bunch at this point, even in consecutive years when different tax kinks are refund maximizing. (*JEL* H24, H26, H31)

A large public finance literature has arisen in the past ten years which relies upon bunching at kink points to estimate behavioral elasticities. A kink is an income amount for a given taxpayer at which marginal tax rates change discretely, marking the end of one tax bracket and the beginning of the next. Standard economic theory predicts that some taxpayers will avoid brackets with relatively high tax rates by bunching at kinks where tax rates increase, resulting in extra mass in the distribution of income close to these kinks (Saez 2010). The magnitude and evolution of bunching provide information regarding how taxpayers are responding to the tax system and the changing nature of their responsiveness.

This paper presents the most comprehensive study to date of income bunching by individuals at kinks in the United States' tax schedule. Our study uses nationally

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representative panel data drawn from the universe of federal income tax returns in the United States from 1996 to 2014. With 257.5 million observations in total, most of our estimators—including those for narrowly defined tax unit types in a given year—use tens or hundreds of thousands of observations, resulting in smooth distributions over the intervals surrounding kinks. Our sample period covers several major tax acts, allowing us to observe changes in bunching patterns in response to changes in kink locations. We use this policy variation to investigate why bunching occurs at some kinks but not others.

We examine kinks created by changes in tax brackets (i.e., statutory tax rates) and by the phasing in and out of tax credits and deductions. While most large kinks are at the bottom of the income distribution—such as those created by the Earned Income Tax Credit (EITC), Child Tax Credit (CTC), or Making Work Pay Tax Credit (MWPTC)—we also observe kinks higher in the income distribution, including statutory kinks in federal and state tax schedules and kinks created by the phaseout of personal exemptions and itemized deductions.

Prior research has found income bunching in the United States at several tax schedule discontinuities, including the first EITC kink (Saez 2010; Chetty, Friedman, and Saez 2013), the Saver's Credit notch (Ramnath 2013), the tuition deduction notch (Hoxby and Bulman 2016), real estate tax notches (Kopczuk and Munroe 2015), and kinks in the corporate tax schedule (Patel, Seegert, and Smith 2017).[1] In terms of the number of taxpayers bunching, the majority occurs at the first EITC kink, which marks the lowest income value taxpayers can report and still maximize the refundable tax credit. This has raised questions about the mechanisms and motives for bunching.

In particular, Saez (2010) finds bunching only among self-employed taxpayers and only at the first EITC kink, not at the second EITC kink or at the largest kink in the statutory schedule. As Saez notes, a potential explanation for this is that some taxpayers may earn or report incomes to maximize refunds. However, an alternative explanation is that kinks other than the first EITC kink may not be large enough to overcome optimization frictions that prevent bunching, including the costs of learning about incentives and responding to them (Chetty 2012). There is some evidence that taxpayers in the United States (Chetty and Saez 2013; Feldman, Katuščák, and Kawano 2016; Liebman and Zeckhauser 2005) and in France (Aghion et al. 2017) are confused by the tax system they face, and it is likely that many taxpayers have imperfect knowledge of the magnitudes and locations of tax kinks. Saez is unable to distinguish between these hypotheses because his sample period, 1960 to 2004, saw little variation in the identity of the refund-maximizing kink for self-employed taxpayers following the introduction of the EITC. Our sample period, in contrast, includes multiple changes in the identity and location

[1] In the United States, the bunching approach has also been used to analyze responsiveness to the annual earnings test for Social Security income (Burtless and Moffitt 1984; Friedberg 2000; Gelber, Jones, and Sacks 2013; Gelber et al. 2017), the timing of capital gains realizations (Dowd and McClelland 2019), and healthcare subsidies (Einav, Finkelstein, and Schrimpf 2017; Kucko, Rinz, and Solow 2018). Elsewhere, bunching has been studied at discontinuities in tax schedules in Denmark (Le Maire and Schjerning 2013), Sweden (Bastani and Selin 2014), Pakistan (Kleven and Waseem 2013), Ireland (Hargaden 2018), and the United Kingdom (Devereux, Liu, and Loretz 2014; Tazhitdinova 2015). Kleven (2016) discusses this research as well as other applications of the bunching approach in the tax literature and beyond.

of the refund-maximizing kink for both wage earners (who now respond) and the self-employed.

We make four contributions to a better understanding of bunching behavior. First, we measure the overall extent of bunching at tax kinks in the United States, documenting growth in bunching and the emergence of responsiveness at new kinks. Second, using changes in the tax schedule due to tax reforms, we show that many taxpayers gravitate toward the unique point of the tax schedule that maximizes the refund they receive. We argue that this behavior is at odds with recently developed methods that use bunching patterns to identify the elasticity of taxable income. Third, we show that bunching at refund-maximizing kinks is partly driven by persistence: taxpayers who bunch at refund-maximizing kinks in one year are disproportionately likely to maximize refunds the following year, even when the refund-maximizing kink substantially changes location. Fourth, we document the emergence of bunching by wage earners and show that this is driven exclusively by income misreporting.

Figure 1 succinctly demonstrates a few of our findings. The figure displays the earned income distribution of single taxpayers with two children in 2014, both for the total population of these taxpayers and the subset of taxpayers with no self-employment income (i.e., wage earners). The difference between the two represents the self-employed. Several aspects of the graph are noteworthy. Most obviously, there is a large spike in the income distribution at the solid vertical line, which marks the income amount that maximizes refunds for the self-employed. This spike is driven by the self-employed, as the wage earners in the figure do not appear to bunch at this particular kink. The spike towers above the surrounding density. While self-employed taxpayers are greatly outnumbered by wage earners away from their refund-maximizing kink, the opposite is true at the kink. However, at the dashed vertical line, which marks the refund-maximizing kink for wage earners, wage earners show a clear tendency to bunch, and bunching by the self-employed is subdued relative to what we see at their refund-maximizing kink. In sum, bunching in the figure is mostly due to the self-employed, but wage earners bunch as well, and both groups appear drawn to the kinks that maximize their refunds.

Married, self-employed taxpayers with two children provide another illustrative example of our findings (see Figure 6). In 2010, the MWPTC kink and the first EITC kink were nearby—within $1,000 of each other. The MWPTC and EITC kinks changed tax rates by 6 percentage points and 40 percentage points, respectively. Nonetheless, bunching was actually slightly stronger at the former kink, which maximized refunds for 93 percent of this group. In 2011, two things changed: the MWPTC no longer existed, and payroll tax rates were temporarily reduced by 2 percentage points. For 85 percent of this group, these relatively minor changes meant they could now attain maximum refunds at the CTC kink, which begins the region where the CTC is maximized. Accordingly, the distribution of income saw a major shift such that bunching now peaked at the CTC kink. The distribution changed little in 2012, but in 2013 the payroll tax holiday expired, and the refund-maximizing kink became the first EITC kink for 93 percent of this group. A large portion of taxpayers responded immediately, with bunching plummeting at the CTC kink and rising dramatically at the first EITC kink.

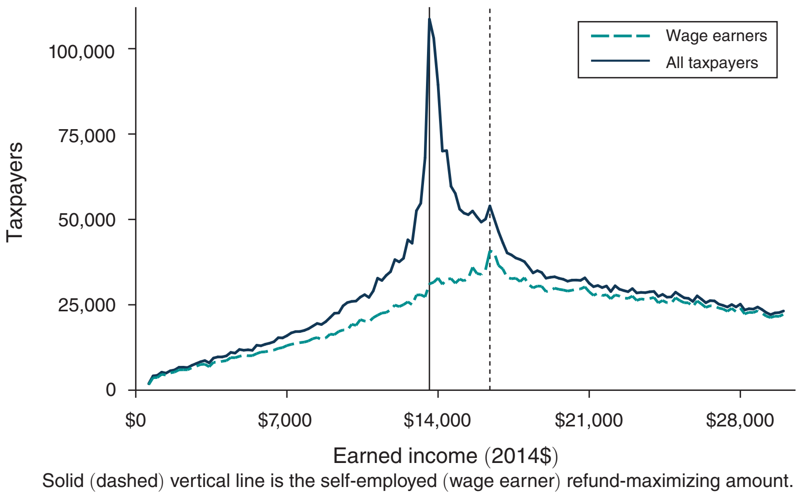

Figure 1. Pooled Distribution of Taxpayers: Single Taxpayers with Two Children in 2014

Notes: The density of earned income is displayed for single taxpayers with two dependents in 2014. The total number of taxpayers and total number of wage-earning taxpayers are displayed in each $200-wide bin. Wage earners are defined as taxpayers without self-employment income. The solid vertical line marks the first EITC kink, which maximized refunds for 92 percent of self-employed taxpayers. The dashed vertical line marks the CTC kink, which maximized refunds for 100 percent of wage earners. Single status includes "head-of-household" filers. These figures were created by the authors using data from the population of tax returns and have been weighted to represent the full US population.

The behavior described in the preceding paragraph, wherein some fraction of taxpayers target maximum refunds, is inconsistent with the models of taxpayer behavior used to translate bunching patterns into elasticities of taxable income by Saez (2010) and Chetty et al. (2011), among others. A standard assumption underlying these estimators is that taxpayers respond to marginal changes in tax rates by marginally adjusting their reported taxable incomes. Given fixed elasticities, larger kinks see greater amounts of bunching; indeed it is this relationship that allows the researcher to estimate elasticities. Given a fixed kink size and an empirical estimate of the level of bunching response, one identifies the elasticity that is compatible with observed bunching levels. However, suppose that some fraction of taxpayers are infinitely elastic in reporting taxable income. That is, they report income in order to minimize their tax liability, or—equivalently (given fixed withholding decisions)—to maximize their refunds. These taxpayers bunch at refund-maximizing kinks regardless of the size of these kinks, disrupting the link between kink size, bunching levels, and elasticities. Generally speaking, this should give pause to researchers using observed bunching intensity to estimate elasticities in any context where agents may be at a global maximum of their (constrained) objective function in reporting the variable of interest.

In the United States, our evidence indicates that the phenomenon of refund maximization is growing rapidly. In 1996, we estimate that approximately 103,100 taxpayers (0.5 percent of EITC-eligible taxpayers) bunched at refund-maximizing kinks.[2] Bunching in that year was concentrated almost exclusively at the first EITC kink, which marked the maximum possible refund for 96 percent of all taxpayers, assuming EITC eligibility. Over the next two decades, bunching grew steadily at the first EITC kink and spread to other locations in the tax schedule as well, particularly when the identity of the refund-maximizing kink changed. By 2014, we estimate there were 646,600 taxpayers (2.1 percent of EITC-eligible taxpayers) bunching at refund-maximizing kinks. This represents a 527 percent increase in bunching at refund-maximizing kinks during a period when the tax filing population grew by only 20 percent.

Taxpayers' increasing tendency to report incomes at the refund-maximizing kink is especially remarkable given that relatively sophisticated calculations are needed to determine the optimal income level to report. Two candidates for informing taxpayers of bunching incentives are paid preparers and tax-filing software. In probit regression analysis, we find that a proxy for the latter (electronic self-filing) is more strongly correlated with locating near the refund-maximizing kink than the former. Moreover, the rise of refund maximization we document occurred during a period of growing usage of tax-filing software and relatively stable usage of paid preparers. An alternative explanation for the rise in refund maximization, though, is that taxpayers may learn about bunching incentives from their neighbors. Consistent with this hypothesis, Chetty, Friedman, and Saez (2013) documents substantial geographic heterogeneity in EITC bunching, with bunching appearing to spread across the nation slowly, emanating from the US south.

Regardless of how taxpayers learn about bunching incentives, the most common way taxpayers bunch at refund-maximizing kinks is by reporting self-employment income. Though the self-employed constitute only 12 percent of taxpayers overall, we estimate that 80 percent of bunchers are self-employed. Moreover, in 2014, we estimate that 11 percent of EITC-eligible taxpayers with self-employment income bunch at their refund-maximizing kink. This raises the question of whether their bunching reflects distortions of real economic behavior or merely reporting decisions, as the self-employed are known to exhibit higher rates of noncompliance (Slemrod 2007, Internal Revenue Service 2016). We cannot definitively answer this question with our data, which are preaudit, as we observe only what taxpayers report at the time of filing. However, we do find that self-employed taxpayers who lack third-party reports of earnings are more likely to locate near refund-maximizing kinks. Moreover, we show that wage earners inflate their employer-reported wages, which show no bunching, in order to bunch. In other words, we find that the excess mass of wage earners near kinks is wholly due to misreported wages. However, we caution that we do not observe whether claimed tax credits or refunds are ever paid out, nor if they are later adjusted by the IRS.

The remainder of this paper is organized as follows. Section I describes the data used in the analysis and the features of the tax system that produce bunching. Section II presents our approach to estimating bunching intensity and documents

[2] This is a subset of the total mass at these kinks. Specifically, it is the excess mass lying above the counterfactual density that would prevail at the kink if nearby densities continued smoothly. See Section IIA for further details on this estimation technique.

bunching at several kinks. Section III provides evidence of refund maximization and explores possible mechanisms for bunching and refund maximization. Section IV concludes by discussing the implications of our findings for estimating behavioral elasticities via the bunching method.

I. Data and Institutional Background

In this section we describe our data and relevant institutional details. We begin with an overview of our data sources, followed by a discussion of the tax code as it pertains to refund-maximizing kinks in the United States during our sample period.[3]

A. *Data*

Our analysis of taxpayer bunching uses data drawn from the population of federal income tax returns (filed by taxpayers) and information returns (typically filed by third parties) of individuals in the United States. Each observation in our data represents a tax unit—all individuals appearing on the same tax return—for a given year. The tax return data give various sources of income as well as deductions, credits, taxes paid, and demographic information such as marital status, number of children, address of residence, and years of birth of those in the tax unit. All data derived from tax returns are preaudit and therefore reflect what taxpayers report when filing, including any errors. From information returns we observe employer-reported wage income (Form W-2), independent contractor income (Form 1099-MISC), credit card payments received (Form 1099-K), and long-term disability payments (Form SSA-1099). We also use information on date of birth and sex at the time of birth from the Social Security Administration's Data Master File (Social Security Administration 2019).

For most of the analysis, we use a panel of 258 million tax returns that is representative of the tax-filing population in the United States in every year from 1996 to 2014. We refer to this sample as the Main Sample.[4] Each year of data in the Main Sample contains a random selection of tax units with a 10 percent sampling probability based on a unique, time-invariant identifier for the primary filer (i.e., the taxpayer listed first on the return). The panel is unbalanced, as taxpayers may be primary filers one year but not the next. This causes complications when we study whether the same taxpayers persist at kinks year after year. For this reason, when we track taxpayers over time, we supplement the Main Sample with an auxiliary dataset that includes all observations of tax units in which the secondary filer is a primary

[3] In addition to kinks created by refundable tax credits, we test for bunching at kinks created by federal statutory rate brackets, the American Opportunity Tax Credit (AOTC), phaseouts of itemized deductions and personal exemptions, and the largest high-income kinks created by state tax regimes, which occur in California, Connecticut, and New Jersey. While these kinks are smaller than those associated with refundable tax credits, they offer an opportunity to measure responsiveness by higher income tax units. Descriptions of these kinks are left to online Appendix C. In preparing this paper, we also tested for bunching at kinks related to income eligibility thresholds for Medicaid, the Supplemental Nutritional Assistance Program, and disability insurance. We found no responses to these programs; however, annual tax data are not well suited to analyze these programs, whose eligibility criteria are often functions of monthly income.

[4] Online Appendix B presents summary statistics for our Main Sample.

filer in at least one year in our Main Sample. We refer to this augmented sample as the Combined Sample.

For certain high-income kinks, where the distribution of income is thin, 10 percent of the tax-filing population is insufficient to distinguish bunching patterns from noise. For these kinks we use the full population of tax units in the neighborhood of the kink. These include the four highest-income kinks in the federal statutory schedule during our period of study and effective kinks created by phase-outs of personal exemptions and itemized deductions. We also use the full population of tax returns from 2003 to 2014 in California, Connecticut, and New Jersey in the neighborhood of each state's largest kink.

B. *Refund-Maximizing Kinks*

We calculate tax liability—conditional on earned income, state of residence, filing status, number of dependents, and self-employment status—using the National Bureau of Economic Research's TAXSIM software (Feenberg and Coutts 1993).[5] This allows us to identify the locations of refund-maximizing kinks conditional on these demographics. Conceptually, the relevant tax rates are those that apply at the time of filing the tax return; therefore we omit payroll taxes for wage earners but include them for the self-employed. This is because payroll taxes on wage income are withheld prior to filing, whereas the equivalent taxes on self-employment income (Self-Employment Contributions Act taxes) are calculated on Schedule SE of the tax return.

Throughout the paper, we make the simplifying assumption that all child dependents below the age of 19 are eligible for both EITC and CTC purposes. This introduces some measurement error, as children above the age of 16 are ineligible for the CTC, and children without social security numbers are ineligible for the EITC. In addition, whenever taxpayers can maximize refunds by reporting a range of incomes where effective marginal tax rates are exactly zero, we resolve the ambiguity by assigning the label "refund-maximizing kink" to the lower bound of the income range. Finally, for taxpayers with both wage and self-employment income, we assume the latter is the relevant income type for marginal tax rate calculations.

When discussing the locations of refund-maximizing kinks, it is helpful to distinguish taxpayers with and without children and those with and without self-employment income. Almost all of the bunching responses we observe are due to self-employed taxpayers with children, and the remainder are mostly due to wage earners with children. The childless have little incentive to maximize refunds. For such taxpayers, the EITC subsidizes income at a rate of 7.65 percent. If reporting self-employment income, this subsidy is outweighed by Self-Employment Contributions Act (SECA) taxes that increase effective marginal tax rates by roughly 15 percentage points. Thus self-employed taxpayers with zero children can generally minimize their tax liability—or, equivalently, maximize their refunds (given fixed withholding decisions)—only by reporting no income.

[5] TAXSIM is accessible online at http://www.nber.org/taxsim/.

Childless wage earners, on the other hand, already have payroll taxes withheld and therefore always see their refund-maximizing kink occur at positive income amounts due to the EITC subsidy. For most years of our sample, these taxpayers could maximize refunds by reporting income at the first EITC kink, where the marginal subsidy ends. Two exceptions are 2009 and 2010, when the temporary Making Work Pay Tax Credit (MWPTC) was available. This credit subsidized earned income up to roughly \$6,500 for singles and twice that for married couples filing jointly, introducing a kink where marginal tax rates increased by about 6 percentage points. This kink, which lay beyond the first EITC kink, marked the new refund-maximizing spot for around 90 percent of taxpayers in these years. Nonetheless, we do not see much bunching responsiveness among this group.

Instead, as mentioned above, bunching responses are concentrated among taxpayers who claim dependent children on their tax returns. For this group the EITC subsidizes income at rates between 34 and 45 percent, creating large kinks where the subsidy ends. After a plateau region where the credit is constant, the EITC begins phasing out at rates between 16 and 21 percent at the second EITC kink. From 1996 to 2007, virtually all taxpayers with children saw their refund-maximizing kinks at either the first or second EITC kink, and for over 90 percent of self-employed taxpayers with children it was the first EITC kink. Then in 2008 a change to the CTC schedule made the CTC kink the refund-maximizing income amount for the majority of wage earners with children; however, for 91 percent of self-employed taxpayers with children, the first EITC kink remained the refund-maximizing amount.

In Section IIIA, we provide graphical evidence of responses to the payroll tax holiday of 2011 and 2012, which reduced payroll and SECA taxes by about 2 percentage points. This small change in marginal tax rates shifted the location of the refund-maximizing kink for many self-employed taxpayers. Nearly two-thirds of those with children saw the CTC kink maximize refunds during these years. In 2013, with full payroll and SECA rates restored, the first EITC kink reclaimed its refund-maximizing status for 93 percent of self-employed taxpayers with children. Bunching responses to these shifts in the location of the refund-maximizing kink can be seen in Figures 5 and 6.

II. Methods and Bunching Estimates

In this section, we describe how we estimate the number of bunchers at a given kink, and we summarize our bunching estimates across a number of kinks.[6]

A. *Estimation Technique*

When quantifying bunching behavior, the key issue is how taxpayers would behave in the absence of a kink. In particular, one must specify an alternative (local)

[6] We provide our complete set of estimates of the number of bunchers at several kinks, broken out by year, filing status, and self-employment status in the online Appendix. We also provide a complete set of figures showing bunching (or the lack thereof) in income distributions, broken out by year, filing status, number of dependents, and self-employment status.

tax schedule as well as the (local) distribution of income under the alternative tax schedule. Let t_0 denote the marginal tax rate that applies below a given kink, and t_1 the rate that applies above it. Let z^* denote the location of the kink. We follow Chetty et al. (2011) in estimating the counterfactual scenario in which t_0 applies both above and below z^* within a certain distance surrounding the kink (the "bunching region"). This removes the kink within the region of study, and therefore removes the incentive to bunch. It also changes the marginal tax rate faced by those with incomes weakly greater than z^*.

To measure the amount of bunching, we compare the actual distribution of income with the predicted counterfactual distribution of income under tax rate t_0. We call this counterfactual density h_0, and we estimate it using a variation of the Chetty et al. (2011) technique. This method predicts the counterfactual income distribution using observed data near the kink but not so close as to be affected by bunching behavior. Specifically, we group taxpayers into bins and fit a third-degree polynomial in distance to the kink, excluding the bins immediately surrounding the kink (the "bunching window") where bunching may possibly occur. Our default parameter values, which we select by visual inspection, are a bunching region of $\pm$\$6,000, a bunching window of $\pm$\$1,500, and a bin width of \$100.[7] Our counterfactual densities are therefore derived from the actual distribution of income between \$1,500 and \$6,000 away from each kink.[8]

We refer the reader to Chetty et al. (2011) for more details regarding the estimation technique, but one aspect is worth highlighting here. When estimating h_0, one must decide where to reallocate the bunchers. We follow Chetty et al. (2011) by reallocating them above the bunching window but within the bunching region. This enforces an integration constraint whereby the total number of taxpayers within the bunching region is identical in the actual and counterfactual densities. Under the standard model of labor supply, where small decreases in marginal tax rates lead to small increases in earnings, this counterfactual behavior is plausible. Under an alternative model in which some bunchers pursue maximum refunds, some of the mass should be reallocated outside of the bunching region (to the next highest kink), violating the integration constraint. Since we cannot identify these pure refund maximizers in the data, we do not attempt this. Thus our counterfactual density h_0 may be biased upward inside the bunching region, causing us perhaps to undercount bunchers. Figure 2 depicts an example of our estimation technique for a selected demographic near the first EITC kink in 2005. The estimated number of bunchers is simply the sum of the (positive or negative) differences between the observed and counterfactual distributions of income in each bin within the bunching window.

In a few instances, two kinks are too close together to perform the analysis as described. Suppose we wish to analyze kink K, but kink L lies somewhere inside K's bunching window. Then the above method may mistakenly identify bunchers at kink L as responding to kink K. Similarly, when analyzing kink L, some bunchers at kink K may be mistakenly included. This misattributes bunchers, and also

[7] In online Appendix A, we show how our estimates vary with alternative choices of these parameter values as well as alternative polynomial degrees.

[8] All dollar values in this section are adjusted for inflation to 2014 levels.

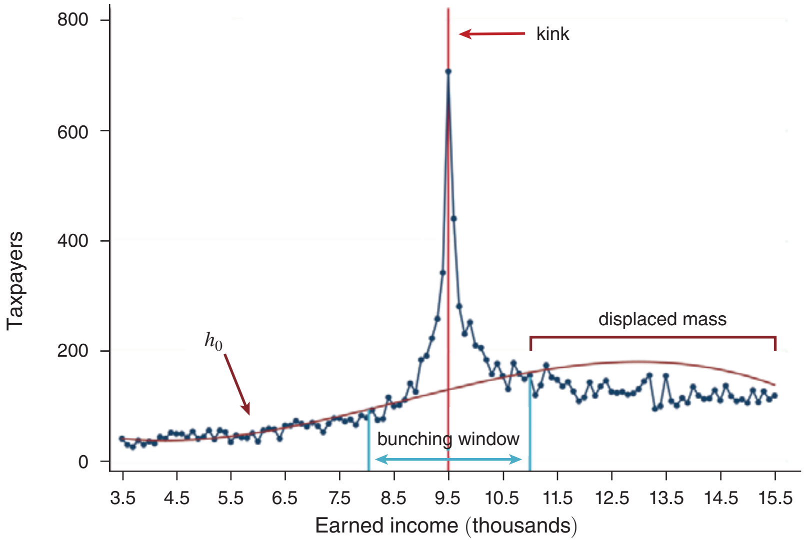

Figure 2. Actual and Estimated Counterfactual Distributions of Income

Notes: The distribution of income is displayed for married couples filing jointly in 2005 who have one dependent and self-employment income. The estimation parameters are the default ones: $R = 35$, $W = 10$, and $\delta = \$100$. Fitted lines h_0 and h_1 denote our estimates for the counterfactual densities of income under the assumptions that the constant marginal tax rate is equal to t_0 (the rate below the kink) and t_1 (the rate above the kink), respectively. This figure was created by the authors using data from the population of tax returns and is unweighted.

causes bunchers to potentially be double counted. To deal with this, in such cases we estimate the total number of bunchers in the usual way, except we divide them into two groups. If kink K sees marginal tax rates change by Δt_K, and kink L sees marginal tax rates change by Δt_L, then we assign fraction $\Delta t_K / (\Delta t_K + \Delta t_L)$ of the bunchers to K and one minus this fraction to L. When reallocating bunchers in the counterfactual h_0, we only reallocate those assigned to the kink being analyzed.

Regardless of whether other kinks are nearby, the total number of bunchers $(\hat{B})$ at a given kink is a flawed metric for comparing the responsiveness of different groups of taxpayers, as some are more numerous than others. Hence we report a bunching coefficient $\hat{b}$ equal to the percentage of taxpayers inside the bunching window who are classified as bunchers.[9] We use a bootstrap procedure to obtain standard errors for $\hat{B}$ and $\hat{b}$ by adding randomly sampled estimated residuals from the original regressions to the predicted values of the original regressions, repeatedly estimating $\hat{B}$ and $\hat{b}$ from the new simulated data.[10]

[9] When analyzing kink K, if kink L is nearby, we adjust both the numerator and the denominator in the definition of K's bunching coefficient, $\hat{b}$, by subtracting the bunchers attributed to kink L.

[10] The Stata code we use to measure bunching is available online at http://www.andrewwhitten.com/stata-code. We thank Raj Chetty, John Friedman, Tore Olsen, and Luigi Pistaferri for public provision of a Stata program designed specifically to implement their estimation technique. Our code builds directly on their work.

B. *Bunching Estimates*

If taxpayers adjust taxable income in response to changes in marginal tax rates, all convex kinks (where tax rates increase) will generate bunching, and all nonconvex kinks (where tax rates decrease) will generate the opposite: a dip in the density of taxpayers (Saez 2010). However, at most kinks there is no evidence of responsiveness in any of the years of our sample. This includes the nonconvex kink at the end of the EITC phaseout region despite strong bunching responses at the convex first and second EITC kinks. We also see no response at most federal statutory kinks and at the state tax kinks we examine.[11] Most surprising though is the lack of meaningful bunching at the convex AOTC kinks, which are quite large (comparable to the EITC kinks) and were present from 2009 to 2014.[12]

Our broad finding of unresponsiveness implies that taxpayers are insensitive to marginal tax rates in the neighborhood of most kinks. This could be driven by several mutually compatible causes. First, gathering information about the tax schedule is costly, and taxpayers may have imperfect knowledge of their local tax schedule (Chetty and Saez 2013). Second, taxpayers may base their decisions on average tax rates rather than marginal ones (Liebman and Zeckhauser 2003; Feldman, Katuščák, and Kawano 2016). Third, taxpayers may know their local schedule and want to respond to marginal incentives but may be constrained by optimization frictions such as adjustment costs or lumpy earnings opportunities (Gelber, Jones, and Sacks 2013). Fourth, if income is sufficiently volatile, taxpayers may be unable to respond to kink points, especially if taxpayers have multiple income earners or income types. However, the last two potential explanations are unconvincing when deduction opportunities are present (e.g., at statutory kinks). Deductions, such as charitable giving, allow taxpayers to precisely manipulate their taxable income at the end of the year, after gross income is observed.

A fifth explanation for the lack of bunching at most kinks is that it may be rational for taxpayers to ignore marginal incentives. Chetty (2012) shows that many kinks are small enough such that ignoring them leads to utility losses of less than 1 percent compared to utility-maximizing choice. In these cases, the benefits of bunching likely do not exceed adjustment costs or the costs of acquiring information regarding tax incentives. In light of this, the lack of responsiveness at most middle-income and high-income kinks is unsurprising.

Taxpayers are not universally unresponsive, however. We observe bunching at several low- and middle-income kinks, particularly those that maximize refundable tax credits. Similar to patterns documented in Saez (2010) and Chetty, Friedman, and Saez (2013), we find sharp bunching at the first EITC kink in all years of our sample. This is where the strongest bunching occurs. We also document bunching at the zeroth statutory kink, consistent with Saez (2010). In addition, we provide new evidence of bunching at the second EITC kink, the CTC kink, the MWPTC

[11] In online Appendix C, we display the lack of bunching at high-income kinks in the federal statutory schedule.

[12] The lack of AOTC bunching is even more surprising given responsiveness to another education-related tax provision that was in effect prior to the introduction of the AOTC: a notch where tuition deductions are abruptly nullified (Hoxby and Bulman 2016).

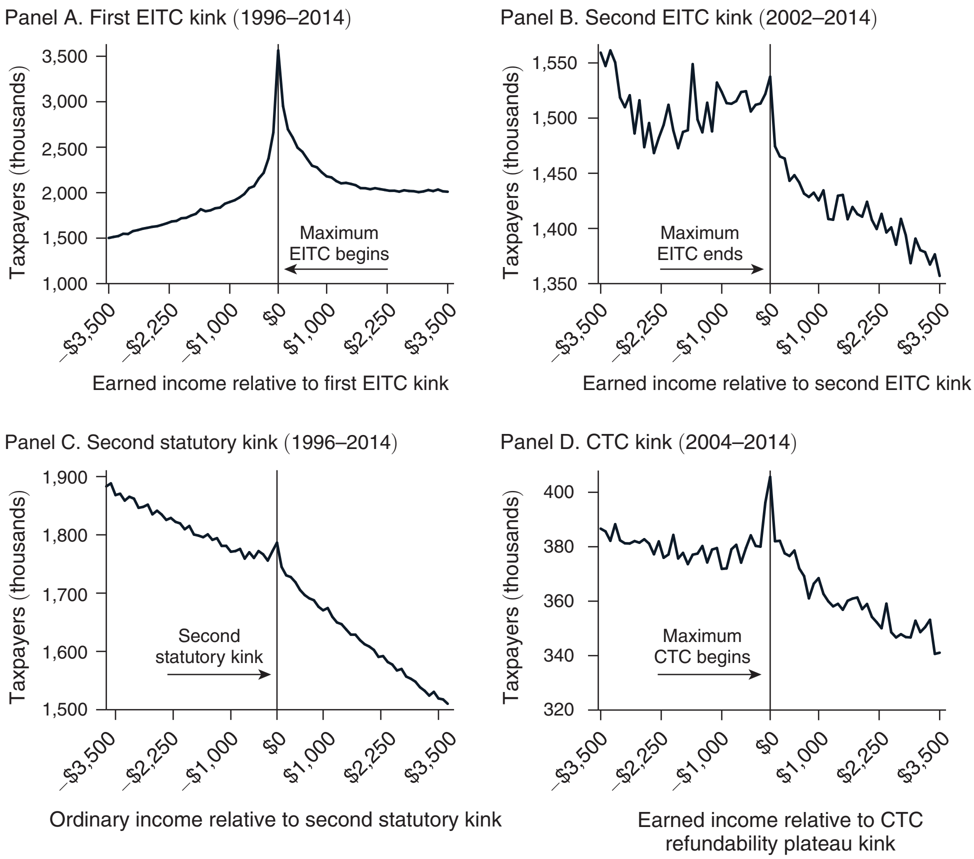

Figure 3. Bunching at Four Kinks

Notes: Panels A, B, and D depict the density of earned income centered around the first and second EITC kinks and the CTC kink, respectively. Panel C depicts the density of ordinary taxable income centered around the second statutory kink. Panels A and B feature all EITC-eligible filers in our Main Sample from 1996 to 2014 and 2002 to 2014, respectively, with the following exception. When the kinks are within \$2,000, we drop all taxpayer types in panel A that respond to the second kink, and we drop all taxpayer types in panel B that respond to the first kink. Panel C includes all taxpayers, except those with investment income, in all years of our sample. Panel D includes all taxpayers in our sample that have children, except those located within \$2,000 of the first or second EITC kinks, from 2004 to 2014. Panels A, B, and D use \$100 binwidths, while panel C uses a \$200 binwidth. All dollar amounts are measured in 2014 dollars. All panels were created by the authors using data from the population of tax returns and have been weighted to represent the full US population.

kink, and the second and third statutory kinks. Responsiveness at the two EITC kinks, the CTC kink, and the second statutory kink are displayed in Figure 3 for selected years and tax unit types.

Though all taxpayers face incentives to bunch at the convex kinks of Figure 3, some taxpayers are more responsive to these incentives than others. To compare bunching patterns across groups, Table 1 presents estimated bunching coefficients at the kinks of Figure 3 using our most recent five years of data, with standard errors in parentheses. In general, the first EITC kink has the most bunching. It sees the largest bunching coefficient, 34.9 percent, corresponding to singles who are self-employed. For this group, we estimate that over one-third of all taxpayers within \$1,500 of the

Table 1—Average Bunching Coefficients at Four Kinks (2010–2014)

	First EITC kink	Second EITC kink	CTC kink	Second statutory kink
Single, wage earners	3.3%	1.6%	3.9%	0.6%
	(1.0%)	(0.7%)	(0.5%)	(0.3%)
	[N = 2,461,800]	[N = 2,570,800]	[N = 2,378,800]	[N = 1,965,400]
Single, self-employed	34.9%	4.9%	21.7%	0.7%
	(1.5%)	(2.2%)	(12.3%)	(1.1%)
	[N = 1,160,500]	[N = 442,600]	[N = 730,700]	[N = 109,900]
Married, wage earners	1.8%	0.4%	1.7%	1.1%
	(2.0%)	(1.5%)	(1.4%)	(0.3%)
	[N = 402,800]	[N = 678,300]	[N = 649,100]	[N = 999,400]
Married, self-employed	19.4%	4.6%	11.1%	1.6%
	(1.7%)	(1.7%)	(1.2%)	(0.8%)
	[N = 301,400]	[N = 291,900]	[N = 336,100]	[N = 173,600]

Notes: Weighted-average bunching coefficients—the percentage of taxpayers within the bunching window that are estimated to be bunching—are reported for various tax unit types, with standard errors in parentheses. In all four columns, the bunching window includes taxpayers within $1,500 on either side of the kink. The number of taxpayers in the bunching region (rounded to the nearest thousand) is presented in brackets. Negative bunching coefficients are recoded as zeros. Wage earners are those with positive wage income and zero self-employment income. The self-employed are those with nonzero self-employment income. Single status includes "head-of -household" filers. Married taxpayers who file separately are excluded. Tax units included for analyses of the EITC and CTC kinks are limited to those with dependents. The income definition is earned income for the EITC and CTC kinks and taxable income for the statutory kink. All figures reflect the authors' calculations using data from the population of tax returns.

first EITC kink during 2010 to 2014 were there because of the change in incentives at the kink.[13]

Bunching, however, is not limited to the self-employed. We observe wage earners (i.e., taxpayers without self-employment income) bunching at many kinks in recent years. The average bunching coefficients for single wage earners at the first EITC kink and the CTC kink are more than three standard deviations away from zero. Though the table does not show it, single wage earners also exhibit statistically significant bunching coefficients at the second EITC kink and the second statutory kink in certain years. In contrast, married-filing-jointly wage earners do not exhibit statistically significant coefficients in Table 1 or in any particular year.

When considering all years of our data, one of the most striking features of the bunching patterns we observe is their evolution over time. In 1996, substantial bunching occurred only at the first EITC kink and only for those with self-employment income. We estimate that the total number of bunchers at the kinks we study was 134,300. By 2014 there is substantial bunching at both the first EITC kink and the CTC kink, including wage-earner bunching. The total number of bunchers had risen by 545 percent to 866,600—including 158,200 wage earners—dramatically outpacing the 20 percent rise in tax returns filed over the same period.

Figure 4 displays this temporal variation. Panel B shows that the number of bunchers at refund-maximizing kinks grew from 103,100 in 1996 to 646,600

[13] When calculating average bunching coefficients, we convert negative coefficients to zeros prior to averaging. Negative numbers imply the kink causes *less* mass to locate near the kink. This is plausible only if taxpayers respond to higher tax rates by earning *more* income, which has little empirical support. As none of the negative coefficients are statistically different from zero, we interpret them as evidence that taxpayers are not responding to the kink.

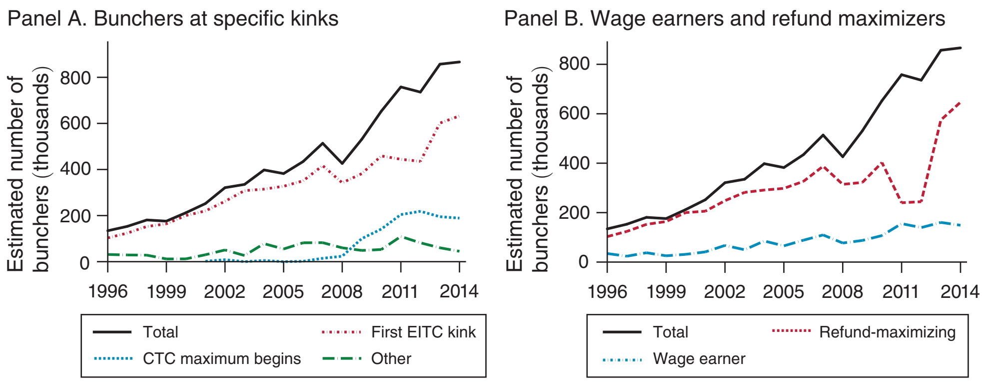

FIGURE 4. BUNCHING OVER TIME

Notes: Estimates for the total number of bunchers at five kinks (the first and second EITC kinks, the CTC kink, the MWPTC kink, and the second statutory kink) are displayed. For a given group at a given kink in a given year, we impose that the number of bunchers is zero whenever the estimated bunching coefficient is less than two times its standard deviation (including instances when the coefficient is negative). Refund-maximizing kinks are identified using NBER TAXSIM. These figures were created by the authors using data from the population of tax returns and have been weighted to represent the full US population.

in 2014—a 527 percent increase. However, the panel also makes evident that this rise was not monotonic. The years 2011 and 2012 stand out as particularly off-trend. During this period, many taxpayers saw their refund-maximizing kink change location and identity. For the majority of taxpayers the refund-maximizing kink was no longer the first EITC kink, where bunching levels generally continued to climb, as panel A of the figure shows. In 2010 just over half of self-employed taxpayers with children (the most responsive tax unit type) had the first EITC kink as their refund-maximizing point. In 2011 this was true for only 13 percent of these taxpayers, and for 65 percent the CTC kink was the new refund-maximizing point. While some taxpayers followed the refund-maximizing kink as it changed location during this period, others did not—perhaps because the difference in liability at the EITC and CTC kinks was small. By 2013, however, the first EITC kink was once again the refund-maximizing kink for 93 percent of self-employed taxpayers with children. Accordingly, two things occur in 2013: the number of refund maximizers returns to its pre-2011 trend, and bunching at the CTC kink falls.

Panel B also shows that substantial wage-earner bunching is a relatively recent phenomenon. This is why we find wage-earner bunching where Saez (2010) and Chetty, Friedman, and Saez (2013) found none, as their samples end in 2004 and 2009, respectively. We estimate that only 34,600 wage-earning taxpayers bunched in 1996; by 2014 this number had risen to 158,200. Among refund maximizers, 92 percent reported self-employment income in 1996, and 86 percent were self-employed in 2014. In contrast, in the general population of taxpayers, only 12 percent report self-employment income. The dominance of self-employment income in bunching naturally raises the question of whether bunching reflects a real economic distortion or merely noncompliance. Unlike wage income, self-employment income is generally not subject to third-party reporting and sees high rates of noncompliance (Slemrod 2007, Internal Revenue Service 2016). However, the self-employed likely have more flexibility in labor supply and are (legally) able to time deductions to manipulate income. While we cannot directly examine whether bunching among the self-employed is due to noncompliance, in Section IIIC we show that self-employed taxpayers with third-party reporting are less likely to bunch at refund-maximizing kinks.[14] Moreover, in Section IIIB we document noncompliance among wage-earner bunchers.

Two additional findings emerge from studying Figure 4. First, panel A shows that bunching in response to the CTC emerges in 2009, when that kink changed locations due to the American Recovery and Reinvestment Act and maximized refunds for about half of our sample. The total number of CTC bunchers rapidly ascended to levels previously seen only at the first EITC kink. This is especially noteworthy given that the CTC kink changes effective marginal tax rates by 15 percentage points, whereas the first EITC kink sees effective marginal tax rates rise by up to 45 percentage points. Second, bunching at the first EITC kink (and, consequently, overall bunching) drops in 2008 at the onset of the Great Recession, as depicted in panel A, even though that kink remained refund maximizing for essentially the same portion of the population. An intriguing hypothesis is that economic downturns may influence taxpayers' ability to bunch, consistent with evidence from Ireland during the Great Recession (Hargaden 2018). If this conjecture holds, it would suggest that bunching involves real distortions of economic activity for some taxpayers.

III. Evidence of Refund Maximization

From our general survey of bunching, we have noted that refund-maximizing kinks capture a large fraction of overall bunching at tax kinks in the United States. We begin this section with graphical evidence that certain groups in certain years tend to track the refund-maximizing kink as it moves and remain at the refund-maximizing kink when it does not move. We then document these trends using regressions that pool different groups and years of our sample. We also explore mechanisms for refund maximization. In particular, it remains unclear whether taxpayers bunch at refund-maximizing kinks by altering real economic activities or via reporting phenomena. In what follows, we provide evidence of the latter.

A. *Graphical Evidence of Refund Maximization*

Saez (2010) provides prima facie evidence that some taxpayers are drawn to the refund-maximizing kink. However, in his data, bunching only occurs at the refund-maximizing first EITC kink. Thus is it difficult, if not impossible, for Saez to

[14] In a tax audit experiment in Denmark, Kleven et al. (2011) finds that around half of the bunching response of the self-employed is eliminated postaudit. In the United States, the IRS has acknowledged that "Fictitious Schedule C's especially those with no 1099 Misc support or no supporting income or expense records that qualify for or maximize EITC is a growing problem." See https://www.eitc.irs.gov/tax-preparer-toolkit/frequently-asked-questions/earned-income-self-employment-income-and-business, accessed July 3, 2019. Additionally, LaLumia, Sallee, and Turner (2015) finds that, among self-employed taxpayers who enter the EITC phase-in region due to the birth of a child in December, many respond by "raising their reported income to an amount that maximizes their refund" (16).

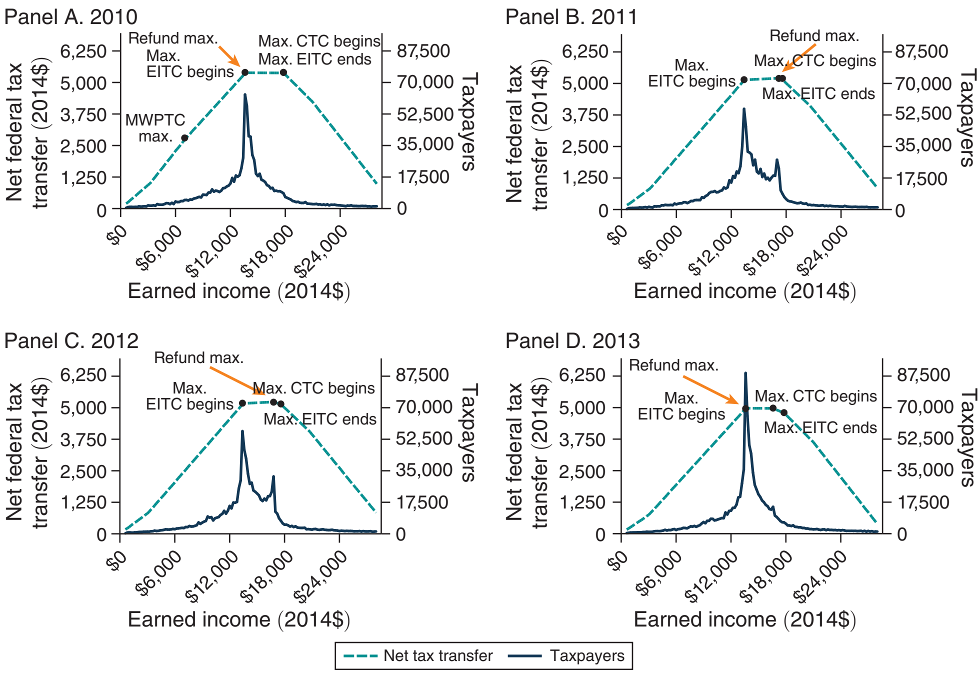

Figure 5. Tracking the Refund-Maximizing Kink: Self-Employed Singles with Two Children

Notes: Annual income distributions are displayed for single taxpayers with two children and positive self-employment income in 2010–2013. The orange arrow denotes the refund-maximizing kink for the majority of taxpayers in each year. Specifically, the refund-maximizing kink for these taxpayers is the first EITC kink for 92 percent in 2010, 24 percent in 2011 and 2012, and 93 percent in 2013 and the CTC kink for 58 percent in 2011 and 2012. Single status includes "head-of-household" filers. All dollar amounts are measured in 2014 dollars. All panels were created by the authors using data from the population of tax returns and have been weighted to represent the full US population.

distinguish whether this kink is especially salient to taxpayers because it maximizes their refund or for other reasons (e.g., imperfect information about other kinks). Here we present graphical evidence that supports the idea that taxpayers are especially drawn to refund-maximizing kinks, including non-EITC kinks.

Consider Figure 5, which shows the evolution of the income distribution for self-employed singles with two dependents from 2010 to 2013. In all panels, the point in the schedule that results in the maximum refund for the majority of taxpayers is marked by an orange arrow. In 2010 this point is the first EITC kink for this group. However, in 2011 the refund-maximizing point shifted to the CTC kink. This happened for two reasons. First, the CTC kink, which is not indexed to inflation, dropped below the second EITC kink, which is indexed to inflation. Second, a temporary 2 percentage point reduction in employee payroll taxes was enacted in 2011 as part of the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010. At the federal level, this changed effective marginal tax rates above the first EITC kink from slightly positive to slightly negative.

Evincing their sophistication, some taxpayers immediately respond to this minor change in the tax code. Relative to 2010, the 2011 income distribution

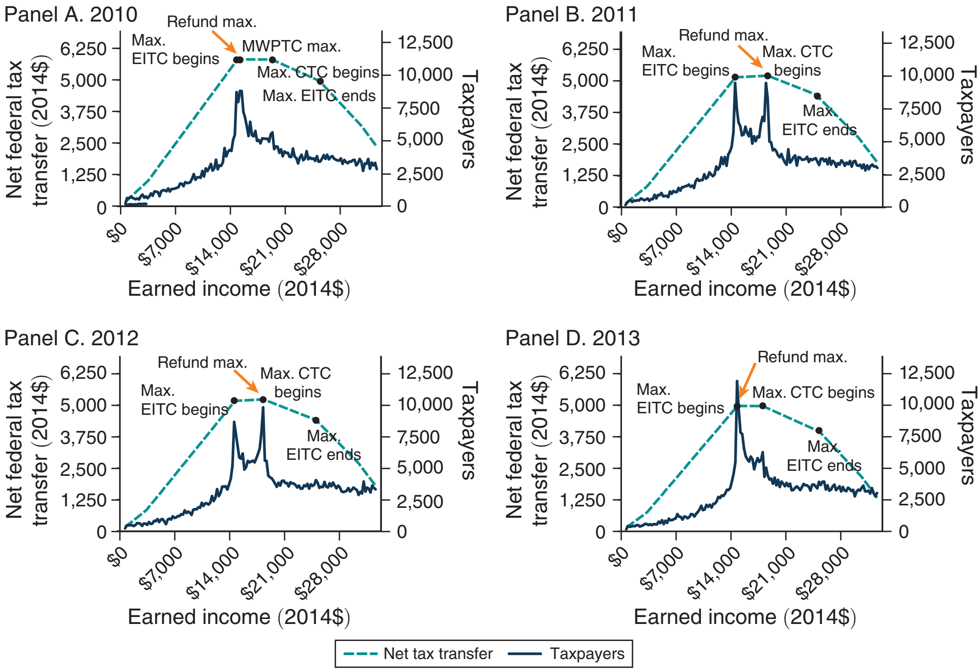

Figure 6. Tracking the Refund-Maximizing Kink: Married Couples with Two Children and Self-Employment Income

Notes: Annual income distributions are displayed for married taxpayers with two children and positive self-employment income in 2010–2013. The orange arrow denotes the refund-maximizing kink for the majority of taxpayers in each year. Specifically, the refund-maximizing kink for these taxpayers is the MWPTC kink for 93 percent in 2010, the CTC kink for 85 percent and 82 percent in 2011 and 2012, and the first EITC kink for 93 percent in 2013. Married-filing-separately taxpayers are excluded. All dollar amounts are measured in 2014 dollars. All panels were created by the authors using a random sample of data from the population of tax returns and have been weighted to represent the full US population.

features significantly less bunching at the first EITC kink and significantly more at the CTC kink. The following year, the distribution of income looks similar, as the CTC kink remains the point in the schedule that maximizes refunds for the majority of taxpayers. Then, in 2013 the payroll tax holiday expires and the first EITC kink reclaims its status as the refund-maximizing kink. Once again, taxpayers immediately respond by shifting to the new optimum; bunching plummets at the CTC kink while it soars at the first EITC kink.

We see this behavior among married couples as well. Figure 6 displays income distributions for the married counterparts to Figure 5. These taxpayers also see the refund-maximizing point in the schedule shift to the CTC kink in 2011 and to the first EITC kink in 2013. Similar to their single counterparts, some taxpayers respond immediately to each of these shifts.[15] However, it is not clear from Figures 5 and 6

[15] By itself, panel A of Figure 6 also provides evidence of refund maximization. The distribution of income in panel A features separate spikes at both the EITC and MWPTC kinks, suggesting some taxpayers were responding specifically to the MWPTC. This is surprising, as the MWPTC kink changed marginal tax rates by only

whether individual taxpayers are moving from kink to kink or whether different sets of taxpayers bunch at different kinks. In Section IIID, we show that, in fact, many individuals do track the refund-maximizing kink when it shifts location.

B. *Wage-Earner Bunching: Real or Reporting Response?*

The rise in wage-earner bunching documented in Section II deserves special attention. Unlike self-employment earnings, wages are generally reported by third parties to the Internal Revenue Service on Form W-2. Due to this third-party reporting, wage income has been shown to exhibit significantly less noncompliance than self-employment income (Slemrod 2007, Internal Revenue Service 2016). Thus, wage-earner bunching provides prima facie evidence of real labor supply or real labor demand responses. However, it remains possible that wage-earner bunching is due to noncompliance, particularly in light of the evidence of Ramnath and Tong (2017), which documents bunching in misreported wage earnings in response to the Economic Stimulus Act of 2008. Like Ramnath and Tong, we directly test for noncompliance by comparing taxpayer- and employer-reported incomes. The former comes directly from line 7 of Form 1040. For the latter, we sum wage income across all Forms W-2 filed for a given taxpayer (or his spouse) and add to this any additional wage or tip income reported on Forms 4137 or 8919.[16]

Our results indicate that the excess mass of wage earners near kinks is wholly due to misreported earnings. To illustrate, panels A and B of Figure 7 display the distributions of taxpayer- and employer-reported wage income for taxpayers with two children in 2014. The patterns are broadly similar for those with different numbers of children in other recent years. Relative to employer-reported income, taxpayer-reported income features additional mass in the EITC plateau region (between the two solid vertical bars) for the single taxpayers of panel A. This extra mass exhibits sharp bunching precisely at the CTC kink (marked by the dashed bar), which maximized refunds for 99 percent of taxpayers in the figure. Employer-reported wages, on the other hand, show no indication of bunching at any kink. This rules out the possibility of a real labor supply or labor demand response to kinks, leaving noncompliance as the culprit.[17]

The evidence is different for the married taxpayers of panel B. There is little excess mass in the EITC plateau region and no bunching in either taxpayer-reported or employer-reported wages. In both panels A and B, we see more mass in taxpayer-reported wages above $15,000. However, in both cases the two lines spike

6 percentage points, whereas the first EITC kink changed rates by 40 percentage points for this group. Standard models of taxpayer behavior, which predict bunching responses proportional to kink size, are difficult to reconcile with the observed distribution of income peaking at the smaller MWPTC kink. However, for around 93 percent of taxpayers included in panel A, the MWPTC kink marked the unique spot in the income distribution that maximized their refunds.

[16] Any wage or tip income not reported by the employer on Form W-2 is required to be reported by the taxpayer on Forms 4137 and 8919. Thus, any mismatch between our employer- and taxpayer-reported income measures necessarily reflects noncompliance.

[17] Some bunching may be due to identify theft, wherein a criminal obtains a social security number and files a fraudulent return, attempting to collect the victim's refund. To the extent this behavior is detected by the IRS at the time of filing, such returns are not included in our data.

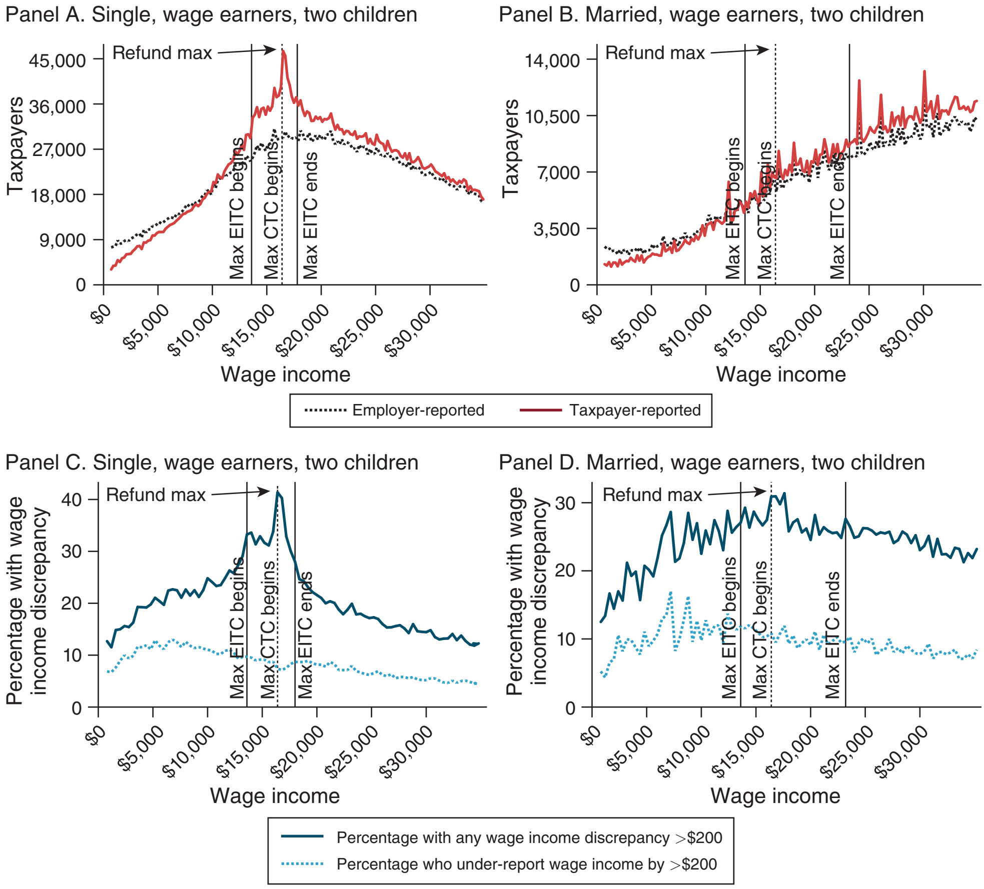

Figure 7. Taxpayer- and Employer-Reported Wage Income (2014)

Notes: Distributions of taxpayer- and employer-reported wages from $600 to $35,000 are displayed in panels A and B for single and married taxpayers, respectively. Panels C and D show the percentage of taxpayers who report income in a certain bin who have a mismatch between their taxpayer- and employer-reported incomes of more than $200. The solid vertical bars mark the first and second EITC kinks, and the dashed vertical bar denotes the CTC kink. In all panels, the CTC kink maximized refunds for 99 percent of taxpayers depicted. Wage earners are those with positive wage income and zero self-employment income. Single status includes "head-of-household" filers. Married taxpayers who file separately are excluded. Taxpayer-reported wages are taken from line 7 of Form 1040, whereas employer-reported wages are taken from Form W-2 and include additional wage and tip income reported on Forms 4137 and 8919. All dollar amounts are measured in 2014 dollars. All panels were created by the authors using data from the population of tax returns. Panels A and B have been weighted to represent the full US population.

in parallel, suggesting this mismatch is random—perhaps due to imperfect matching of tax returns with Forms W-2.

Panels C and D of Figure 7 corroborate the evidence in panels A and B. The panels display the percentage of taxpayers in a given income bin who have a discrepancy between their employer- and taxpayer-reported incomes greater than $200. For married individuals, there is little evidence of systematic mismatch, save perhaps at the CTC kink. For singles, however, the evidence is clear that taxpayers reporting incomes in the bins containing the first EITC kink and the CTC kink are more likely to have a wage-income discrepancy. Nearly 45 percent of taxpayers in the bin containing the CTC kink have a discrepancy, whereas outside the EITC plateau region the percentages do not exceed 30 and typically fall between 10 and 25.

Panels C and D also indicate that wage income discrepancies are not driven by underreporting. The percentage of taxpayers who underreport wage income does not spike at the kinks. This means bunching due to wage income discrepancies is driven by taxpayers reporting incomes exceeding those their employers report. This is consistent with the incentives taxpayers face in these income regions. When incomes are subsidized—as they are below the CTC kink in this case—reporting extra income decreases tax liability, increasing refunds. Moreover, if taxpayers assume small enough audit probabilities, fabricating wage income yields greater refunds than fabricating self-employment income, as wage income is not subject to payroll tax at the time of filing. Consistent with this reasoning, in Figure 7 taxpayers are particularly likely to overreport wage income in order to bunch at the refund-maximizing CTC kink.

True audit probabilities, however, may not be small. The IRS expends considerable resources auditing taxpayers who claim refundable tax credits, as their tax returns are known to commonly contain errors. Because our data do not contain postaudit outcomes, we do not know whether the refunds claimed by taxpayers are ever paid out or are recovered later through audit procedures. As wage income discrepancies are easily identified, the IRS may detect a large share of this noncompliance.[18]

C. *Correlates of Refund Maximization*

Above we have seen evidence suggesting that the emergence of wage earner bunching is driven by misreporting. Due to the incomplete nature of third-party reporting of self-employment earnings, an analogous exercise for the self-employed is not possible. Instead, in this section we explore the characteristics correlated with refund maximization, using probit regression analyses on a subset of our data beginning in 2005. We test whether certain characteristics, such as the presence of Form 1099s, are correlated with reporting incomes near refund-maximizing kinks. Under the assumption that these characteristics are orthogonal to the likelihood of unintentionally locating near refund-maximizing kinks (conditional on being inside the regression window), the coefficients presented reflect correlations with the likelihood of bunching.

Table 2 displays the results of probit regressions for self-employed and wage-earning taxpayers separately. The dependent variable is an indicator for whether the taxpayer is within \$(2014)500 of their refund-maximizing kink. The first two columns correspond to a regression window of EITC-eligible taxpayers with earned income within \$(2014)3,500 of the kink, while the last two columns use

[18] In a study of random audits, the IRS estimates that wage income misreporting led taxpayers to overclaim the EITC by around \$0.8 to \$1.1 billion (in 2008 dollars) during the 2006–2008 time period (Internal Revenue Service 2014). Moreover, when EITC claimants are audited, they are less likely to claim the EITC in subsequent years (DeBacker et al. 2018, Guyton et al. 2019).

Table 2—Characteristics of Taxpayers at Refund-Maximizing Kinks (2005–2014)

	Self-employed	Wage earners	Self-employed	Wage earners
Single	8.2	0.7	8.5	0.7
	(0.2)	(0.1)	(0.2)	(0.1)
No 1099	6.0	—	6.4	—
	(0.2)	—	(0.1)	—
No W-2 (*has wages*)	1.3	0.6	1.3	0.5
	(0.7)	(0.2)	(0.6)	(0.1)
Has wages (*no misreporting*)	−2.3	—	−2.5	—
	(0.4)	—	(0.3)	—
Overreports wages (*has wages*)	−2.8	7.2	−2.5	6.2
	(0.5)	(0.1)	(0.4)	(0.1)
Underreports wages (*has wages*)	1.3	0.5	1.5	0.5
	(0.3)	(0.1)	(0.3)	(0.1)
Paid preparer	9.3	0.6	9.0	0.7
	(0.9)	(0.2)	(0.7)	(0.1)
Paper self-prepared	7.3	0.4	7.0	0.4
	(1.0)	(0.2)	(0.8)	(0.2)
Electronic self-prepared	15.9	0.5	15.3	0.5
	(0.9)	(0.2)	(0.7)	(0.1)
Claims children	9.6	0.9	8.5	0.7
	(0.7)	(0.1)	(0.6)	(0.1)
Window around kink	$3,500	$3,500	$5,000	$5,000
Observations	390,635	1,237,050	468,944	1,737,842
Clusters (taxpayers)	184,864	693,538	207,565	852,106
Baseline probability of locating near the kink	33.0	15.2	27.5	10.8
	(0.1)	(0.0)	(0.1)	(0.0)

Notes: Results are displayed for probit regressions where the dependent variable is an indicator for reporting income within $500 of the refund-maximizing kink. The independent variables include those listed in the table; state and year fixed effects; and indicators for changing states, age (decade bins), positive and negative changes in the number of dependents claimed, getting married, and getting divorced. The coefficients are average marginal effects, in percentage points, with standard errors in parentheses. In some cases, the marginal effects are conditional on the italicized terms in parentheses. For example, the marginal effects of not having a W-2 are conditional on reporting wage income. The first and third columns are limited to self-employed taxpayers, while the second and fourth columns are limited to wage earners. The first two columns include taxpayers with earned income within $3,500 of the refund-maximizing kink, while the third and fourth columns expand the regression to include taxpayers within $5,000 of the kink. In all columns the samples are further limited to EITC-eligible taxpayers, and the sampling probability is 2 percent rather than 10 percent as in the Main Sample. In the self-employed regressions, the indicator for not having a W-2 is interacted with the indicator for reporting wages. Wage overreporting and underreporting variables are constructed by comparing wages as reported on Form 1040 to the sum of wages reported on Forms W-2, 4137, and 8919. The omitted preparation type is IRS assisted. Errors are clustered at the taxpayer level. The final row reports the probability of locating near the refund-maximizing kink given the same sample restrictions as the probit regressions, with bootstrapped standard errors in parentheses. All dollar amounts represent 2014 dollars. All figures reflect the authors' calculations using data from the population of tax returns.

a window of $(2014)5,000 as a robustness check. In all columns, a battery of dummy variable covariates are included, detailed in the note below the table, and errors are clustered at the taxpayer level. The coefficients are average marginal effects measured as percentage point increases in the likelihood of locating near that column's kink. In some cases the marginal effects are conditional on the italicized terms in parentheses. For example, the marginal effects of not having a W-2 are presented conditional on reporting wage income.

For wage earners, the indicator for overreporting wage income stands out as the variable with the strongest association with refund maximization. This indicator is associated with roughly a 6 to 7 percentage point increase in the likelihood of refund maximization, relative to a baseline probability of 15.2 percent in the smaller regression window and 10.8 percent in the larger window. All other variables, including the indicator for underreporting wage income, show much weaker correlations, with marginal effects of less than 1 percentage point. This is consistent with Figure 7, where we saw a spike in overreporting but not underreporting of wage income at a particular refund-maximizing kink. Here we see this same pattern holds more generally across all refund-maximizing kinks in our data.

For the self-employed, however, overreporting wage income is negatively correlated with locating near a refund-maximizing kink. This is consistent with rational misreporting, as misreported wage income is easily detected and therefore is not an advantageous strategy for refund maximizers with self-employment income. On the other hand, the self-employed also exhibit a positive correlation between underreporting wage income and refund maximization, which is seemingly inconsistent with rational misreporting. One conjecture that would reconcile these facts is that taxpayers may be hesitant to report negative self-employment income in order to bunch, perhaps fearing high audit probabilities.

A theme throughout the paper is that, relative to wage earners, the self-employed are more likely to bunch in general and at refund-maximizing kinks in particular. Table 2 succinctly conveys the latter point. In both regression windows, the self-employed are more than twice as likely as wage earners to report income at the refund-maximizing kink. As we have emphasized, this could be due to greater ability among the self-employed to distort real economic activity and legally manipulate income in order to bunch. Alternatively, it could be due to the lack of third-party reporting for much of self-employment income, making it easier to misreport income. The probit regressions provide some evidence in favor of the second hypothesis. Both wage earners and the self-employed are somewhat more likely to maximize refunds when no W-2 is present to substantiate wage income (around 0.5 and 1.3 percentage points, respectively). Moreover, the self-employed are around 6 percentage points more likely to maximize refunds when there is no 1099-MISC or 1099-K to substantiate income.

One way taxpayers may learn about refund-maximizing kinks is through paid tax preparers. Relative to the omitted category of IRS-assisted preparation, we do see around a 9 percentage point increase in refund maximization among self-employed taxpayers who use paid preparers. However, we see a similar magnitude for self-employed taxpayers who self-prepare and file by paper (around 7 percentage points). Thus it does not appear that paid preparers, on average, are a substantial driver of refund maximization. Instead, we interpret the coefficients as indicating that IRS-assisted taxpayers are particularly unlikely to maximize refunds.[19] On the

[19] This stands somewhat in contrast to the evidence of Chetty, Friedman, and Saez (2013), which finds that, at the ZIP-3 geographic level, EITC bunching is strongly correlated with the fraction of taxpayers who use paid preparers. It is possible that some paid preparers encourage refund maximization while others discourage it, with effects that roughly offset on average. Their evidence is consistent with a disproportionate concentration of paid preparers who encourage refund maximization in ZIP-3s with high paid-preparer usage.

other hand, we see a dramatically larger coefficient of 15 to 16 percentage points for self-employed taxpayers who self-prepare and file electronically. This raises the possibility that many taxpayers may learn about refund-maximizing kink locations using tax-filing software.

D. *Dynamics in Refund Maximization*

Whereas Table 2 presents a static snapshot of bunchers' characteristics, we now explore two dynamic aspects of bunching: tracking the refund-maximizing kink when it moves and remaining at the kink when it doesn't. The first three columns on the left of Table 3 study the former, displaying the probability of reporting income in certain ranges relative to the refund-maximizing kink in year t, conditional on year $t-1$ income. Importantly, the sample here is limited to taxpayers who saw the refund-maximizing kink move by at least \$2,000[20] between years $t-1$ and t. After experiencing such a large change in the refund-maximizing kink's location, around 24 percent of self-employed taxpayers who were within \$500 of the refund-maximizing kink in year $t-1$ manage to locate near the kink again in year t. For some taxpayers this is unintentional, as not everyone who reports income near a kink is a buncher. To assess the extent to which taxpayers may unintentionally track refund-maximizing kinks, we report the probability of a similar income change either \$2,000 above or below the refund-maximizing kink. We find these probabilities are between 5 and 6 percent, reflecting a baseline amount of income volatility among the self-employed. Differencing out this income volatility yields an estimate that around 18 to 19 percent of self-employed taxpayers maximizing refunds in a given year will intentionally maximize refunds in the subsequent year, conditional on the refund-maximizing kink substantially shifting locations.

The evidence for wage earners is also consistent with tracking refund-maximizing kinks, but to a much lesser extent. Table 3 shows that 5.3 percent of wage earners at the kink in year $t-1$ follow it after it shifts by more than \$2,000 in year t. Much of this is likely unintentional, however, as wage earners \$2,000 above or below the refund-maximizing kink show similar income changes with probabilities of around 4 percent. Nonetheless, our point estimates come with tight standard errors and are statistically different. Differencing out the income volatility, we find that between 1 to 2 percent of wage earners who maximize refunds in a given year will intentionally maximize refunds the following year, conditional on the refund-maximizing kink shifting substantially.

The above fractions for wage earners and the self-employed take as their denominators the number of taxpayers locating near refund-maximizing kinks, intentional or otherwise, in the base year. Thus they place lower bounds on the fractions of wage-earning and self-employed *bunchers* at refund-maximizing kinks who intentionally track the refund-maximizing kink when it shifts substantially. To place upper bounds on these fractions, we perform a similar calculation for years

[20] All dollar figures in this section are given in 2014 inflation-adjusted dollars.

Table 3—Dynamic Responses to Refund-Maximizing Kinks (2005–2014)

Following the refund-maximizing kink				Persistence in income bin	
				Bin $t-1$ maximizes refunds in $t-1$ and t?	
Income in $t-1$ relative to kink	Wage earners	Self-employed		Yes	No
[−\$2,500, −\$1,500]	4.0	5.2	Self-employed	23.0	−0.6
	(0.1)	(0.1)		(0.2)	(0.1)
[−\$500, +\$500]	5.3	23.7	No 1099 (*self-employed*)	13.6	4.1
	(0.1)	(0.1)		(0.2)	(0.1)
[+\$1,500, +\$2,500]	3.7	5.6	No W-2 (*has wages*)	22.2	5.9
	(0.1)	(0.1)		(0.3)	(0.1)
Observations	300,279	137,258	Clusters (taxpayers)	538,793	1,245,518
			Observations	651,867	4,428,596
			Probability of persisting:		
			Wage earners	14.0	10.6
				(0.1)	(0.0)
			Self-employed	40.0	10.6
				(0.1)	(0.0)

Notes: The first three columns show probabilities of reporting income within certain ranges, relative to refund-maximizing kinks, in year t conditional on reporting year $t-1$ income within the given range. The sample is limited to EITC-eligible taxpayers whose refund-maximizing kink moved by at least \$2,000 between years $t-1$ and t, whose self-employment status remained the same in both years, and whose refund-maximizing kink exceeded \$5,000 in both years. Bootstrapped errors are shown in parentheses. The next three columns display probit regression results where the dependent variable is an indicator for whether the taxpayer reported income in the same \$1,000-wide income bin in years $t-1$ and t. The fifth column is restricted to taxpayers whose income bin in $t-1$ maximized refunds in both $t-1$ and t. The sixth column shows other taxpayers and represents a 2 percent random sample rather than 10 percent as in our Main Sample (used in column 5). In both columns, the sample is restricted to EITC-eligible taxpayers with earned income in $t-1$ between \$5,000 and \$50,000. The independent variables are a self-employment dummy and its interaction with an indicator for not having a 1099-MISC or 1099-K, and a dummy for taxpayer-reported wages and its interaction with an indicator for not having a W-2. The coefficients are average marginal effects, measured in percentage points. In some cases, the marginal effects are conditional on the italicized terms in parentheses. For example, the marginal effects of not having a W-2 are conditional on reporting wage income. Errors are clustered at the taxpayer level. All dollar amounts in the table and in this note are given in 2014 dollars. The analyses presented in this table are limited to years 2005 through 2014. All figures reflect the authors' calculations using data from the population of tax returns.

2005–2014 using counts of bunchers in the denominator, conditional on seeing the refund-maximizing kink shift at least \$2,000. For the numerator, we use taxpayers locating within \$500 of the refund-maximizing kink in both years. Because the numerator includes both intentional and unintentional trackers, this calculation overestimates the fraction of bunchers who intentionally track. For wage earners, this calculation results in an upper bound of 66 percent, while for the self-employed we find an upper bound of 26 percent. Combining this with the lower bounds derived from Table 3, we estimate that between 18 to 26 percent of self-employed bunchers at refund-maximizing kinks will intentionally maximize refunds in the subsequent year, conditional on the refund-maximizing kink substantially shifting locations. The corresponding range for wage earners is wider and therefore less useful: 1 to 66 percent.

When kinks do not shift locations, it may be easier to repeatedly maximize refunds. The columns on the right side of Table 3 test this, examining whether taxpayers persist at stationary refund-maximizing kinks. Results from probit regressions are presented. In both the fifth and sixth columns, the dependent variable is an indicator of whether the taxpayer located in the same \$1,000-wide income bin in years $t - 1$ and t, and the sample is restricted to EITC-eligible taxpayers with earned income in $t - 1$ between \$5,000 and \$50,000. The independent variables are a self-employment dummy and its interaction with an indicator for not having a 1099-MISC or 1099-K, and a dummy for taxpayer-reported wages and its interaction with an indicator for not having a W-2. The coefficients are average marginal effects, measured in percentage points. In some cases, the marginal effects are conditional on the italicized terms in parentheses. For example, the marginal effects of not having a W-2 are conditional on reporting wage income. Errors are clustered at the taxpayer level. In the fifth column, the sample is limited to taxpayers whose income bin in year $t - 1$ contains the refund-maximizing kink in both years $t - 1$ and t. Taxpayers who do not meet this condition are sampled in the sixth column, with a sampling probability of 2 percent rather than 10 percent as in our Main Sample.

The baseline probabilities reported at the bottom of the table indicate that both wage earners and the self-employed are more likely to persist in an income bin when it is refund-maximizing (14.0 and 40.0 percent likelihoods) than when it is not (10.6 percent). However, the difference is more stark for the self-employed. Away from refund-maximizing kinks, the self-employed are as equally likely as wage earners to persist in the same income bin from year to year. In refund-maximizing bins, the self-employed are 26 percentage points more likely to persist than wage earners. We note that this does not necessarily follow from the general pattern that the self-employed bunch more than wage earners at refund-maximizing kinks. This goes a step further and demonstrates that the self-employed are more likely to *repeatedly* maximize refunds.

Among the self-employed, the coefficients of the probit regressions indicate that those who do not have Form 1099s to substantiate income are about 14 percentage points more likely to persist at refund-maximizing kinks. Similarly, among wage earners, those who do not have a Form W-2 are around 22 percentage points more likely to persist at refund-maximizing kinks. Both of these coefficients are significantly larger than their counterparts away from refund-maximizing kinks, where the absence of third-party forms increases persistence by roughly 4 and 6 percentage points, respectively, for the self-employed and wage earners. This demonstrates the strong correlation between third-party reporting and persistence in refund maximization.

To further explore the characteristics of taxpayers who track the refund-maximizing kink when it changes locations, Table 4 displays the results of a probit regression analogous to Table 2. Here, the dependent variable is an indicator for reporting income within \$500 of the refund-maximizing kink in year $t + 1$. The sample is limited to EITC-eligible taxpayers who report income within \$500 of the refund-maximizing kink in year t and who see the refund-maximizing kink move by at least \$1,000 between years t and $t + 1$. The independent variables include those of Table 2 as well as the absolute value and the square of the distance the refund-maximizing kink moves. The coefficients have the same interpretation as before, as average marginal effects measured in percentage points.

By construction, the entire sample studied in Table 4 consists of taxpayers who maximize their refunds in at least one year. The coefficients inform us of what characteristics are associated with the subset of this group that track the

Table 4—Characteristics of Taxpayers Following Refund-Maximizing Kinks (2005–2014)

	Self-employed	Wage earners
Single	1.8	2.3
	(0.2)	(0.1)
No 1099s	2.0	—
	(0.2)	
No W-2 (*has wages*)	1.6	2.0
	(0.6)	(0.3)
Has wages (*no misreporting*)	−3.0	—
	(0.2)	
Overreports wages (*has wages*)	1.5	5.9
	(0.5)	(0.2)
Underreports wages (*has wages*)	−0.7	0.3
	(0.2)	(0.2)
Paid preparer	0.4	1.4
	(1.3)	(0.4)
Paper self-prepared	0.2	0.4
	(1.3)	(0.4)
Electronic self-prepared	3.4	1.3
	(1.3)	(0.4)
Claims children	5.4	2.4
	(0.5)	(0.1)
Absolute value of distance kink moves	−1.8	−0.5
	(0.0)	(0.0)
Observations	183,940	178,304
Clusters (taxpayers)	167,069	173,623
Baseline probability of tracking the kink	13.2	6.1
	(0.1)	(0.1)

Notes: Results are displayed for probit regressions where the dependent variable is an indicator for reporting income within \$500 of the refund-maximizing kink year $t + 1$. The sample is limited to EITC-eligible taxpayers who report income within \$500 of the refund-maximizing kink year t and see the refund-maximizing kink move by at least \$1,000 between years t and $t + 1$. The independent variables include those listed in the table; state and year fixed effects; and indicators for changing states, age (decade bins), positive and negative changes in the number of dependents claimed, getting married, and getting divorced. The absolute value of distance the kink moves between years t and $t + 1$ is measured in thousands of dollars, and the square of this measure is also included as a regressor. The first column is limited to self-employed taxpayers, while the second is limited to wage earners. In the self-employed regression, the indicator for not having a W-2 is interacted with an indicator for taxpayer-reported wages. The coefficients are average marginal effects, in percentage points, with standard errors in parentheses. In some cases, the marginal effects are conditional on the italicized terms in parentheses. For example, the marginal effects of not having a W-2 are conditional on reporting wage income. Wage overreporting and underreporting variables are constructed by comparing wages as reported on Form 1040 to the sum of wages reported on Forms W-2, 4137, and 8919. Errors are clustered at the taxpayer level. The final row reports the probability of locating near the refund-maximizing kink in year $t + 1$ given the same sample restrictions as the probit regressions, with bootstrapped standard errors in parentheses. All dollar amounts represent 2014 dollars. All figures reflect the authors' calculations using data from the population of tax returns.

refund-maximizing kink as it moves. Unsurprisingly, the self-employed are more likely than wage earners to track the refund-maximizing kink, with 13.2 and 6.1 percent likelihoods, respectively. We also see that taxpayers are somewhat less likely to track the kink the further it moves. All else equal, when a kink moves

$1,000 further, it reduces the likelihood of tracking by 0.5 and 1.8 percentage points, respectively, for wage earners and the self-employed.

The other coefficients of Table 4 reinforce earlier themes of the paper. Singles are more likely than married couples to track the refund-maximizing kink, and the presence of dependent children is also associated with tracking. In addition, taxpayers who self-prepare returns and file electronically (indicating the use of software) are more likely to track the kink than other preparation types.

The absence of third-party reporting is a strong predictor of tracking the refund-maximizing kink. Among wage earners, not having a W-2 increases the likelihood of tracking by 2.1 percent, and those who overreport wages in the base year are 5.9 percent more likely to track, relative to a baseline probability of 6.1 percent. In contrast, underreporting wages is not associated with tracking. Among the self-employed, those with accurately reported wages are 3.0 percent less likely to track. Those who overreport their wage income, those who have no W-2, and those with no 1099s are all more likely to track, by between 1.5 and 2.0 percent.

Taken as a whole, the results of Tables 3 and 4 indicate that there is a dynamic component to refund maximization. Taxpayers who locate near the refund-maximizing kink in one year have a tendency to locate near the refund-maximizing kink in the subsequent year as well. This is true for taxpayers who see their refund-maximizing kink move substantially and those who do not, as well as for wage earners and the self-employed. Moreover, repeated reporting of income near refund-maximizing kinks is greater among taxpayers who lack third-party documentation of their earnings, particularly for wage earners who overreport income.

IV. Discussion

Our investigation of taxpayer bunching around kink points in the US income tax schedule has revealed new details about the way some taxpayers respond to the tax code. Having examined federal and state statutory kinks, kinks created by tax credits, and kinks created by phaseouts of deductions and exemptions, we have seen that most kinks do not generate statistically discernible bunching responses. In particular, all nonconvex kinks fail to induce an observable response, and we do not detect any responsiveness among high-income taxpayers at the federal or state income tax kinks we study, even when using the universe of tax returns.

However, we do find bunching at seven kinks, including economically meaningful bunching at several large kinks that maximize tax credits, including the EITC, CTC, and temporary MWPTC. While bunching by the self-employed at the first EITC kink has been documented (Saez 2010) and exploited as an indicator of local EITC knowledge (Chetty, Friedman, and Saez 2013), we have uncovered several new facts about taxpayer bunching in the United States. Most notably, we have shown that bunching is particularly responsive at kinks that maximize taxpayer refunds. For many groups, when the refund-maximizing kink changes location between consecutive years, a large mass of taxpayers appears at the new refund-maximizing kink.

Bunching at refund-maximizing kinks is central to the overall story of bunching in the United States. Across all years of our sample, we estimate that 66 percent of the total number of bunchers are located at refund-maximizing kinks. Moreover, we have also shown that the majority of bunching at nonrefund-maximizing kinks occurs at similar low-income kinks that maximize refundable tax credits. Bunchers at these kinks may be responding to tax incentives using rough heuristics for refund maximization, as many achieve refunds just shy of the strict maximum.

Implications for Elasticity Estimates.—When taxpayers report incomes in pursuit of maximum refunds, their behavior is at odds with standard models used in the bunching literature to estimate behavioral elasticities. For example, Figures 5 and 6 depict large shifts in bunching levels in a period when kink sizes remained essentially constant. We typically expect a monotonic relationship between taxpayers' behavioral responses and changes in marginal incentives, implying that the amount of bunching at a given kink should be roughly proportional to its size. This assumption underlies the estimation technique that translates bunching patterns into elasticities of taxable income (Saez 2010, Chetty et al. 2011). All variants of this technique share the property that for a given kink size, higher levels of bunching translate into greater elasticity estimates (Kleven 2016). However, if a nontrivial fraction of taxpayers reports income to maximize refunds, standard methods to calculate elasticities do not apply at refund-maximizing kinks. This is because kink size, which is measured in the denominator of the elasticity, is not a factor in determining the identity of the refund-maximizing kink. The only factor is whether the kink sees marginal tax rates flip from negative to positive.

A simple theoretical model that results in refund-maximizing behavior can be found in Section II.C of Saez (2010); however, the elasticities Saez reports are incompatible with this model. Alternatively, one can conceptualize refund maximization as the solution to a variant of the Allingham and Sandmo (1972) model in which taxpayers may overreport incomes and believe the probability of an audit is approximately zero.

In Figures 5 and 6, the CTC kink sees little bunching in years when it is not the refund-maximizing kink. However, for the brief period when it is refund-maximizing, bunching spikes. If the standard bunching method were applied to estimate elasticities at this kink, it would indicate a much larger elasticity of taxable income for taxpayers near this kink during 2011 and 2012 relative to 2010 or 2013. While this is possible, it seems unlikely given a simpler explanation: some taxpayers do not behave according to the standard model of incremental changes in incomes in reaction to incremental changes in the tax schedule.

Importantly, the problem with standard bunching methods of estimating elasticities is not the idea that taxpayers may be responding to tax rates via the channel of evasion. This is easily accommodated in such models. Where the standard method breaks down is when taxpayers are infinitely elastic in responding to tax rates (whether through legal or illegal means), such that small changes in the tax schedule can cause large, discrete changes in behavior. This is what we see in Figures 5 and 6, and more generally throughout the paper.

Due to this fundamental obstacle with the bunching approach, we do not report elasticities in this paper. In an ideal research design, one could calculate elasticities at refund-maximizing kinks using the standard bunching technique after identifying taxpayers who bunch purely in pursuit of maximum refunds and removing them from the data. This is challenging in our context, as we do not observe which taxpayers behave according to standard models and which report incomes in pursuit of maximum refunds. At nonrefund-maximizing kinks, we could potentially report elasticities; however, we refrain from this as well because the kinks where we see meaningful bunching all share the property that they maximize a refundable tax credit. Thus it is possible many bunchers at nonrefund-maximizing kinks may be naively maximizing one tax credit (e.g., the EITC) as a heuristic approximation to refund maximization. In addition, often there is little difference in the level of refunds provided at refund-maximizing kinks relative to other nearby kinks (e.g., between the MWPTC and the first EITC kink in panel A of Figure 6). It is therefore reasonable to suppose that some bunchers at nonrefund-maximizing kinks may nonetheless be targeting maximum refunds under a satisficing model in which small deviations from the strict optimum are tolerated (or perhaps even preferred if audit probabilities are thought to be higher at refund-maximizing kinks).

When some taxpayers behave according to standard models and some bunch in pursuit of maximum refunds, elasticities calculated at refund-maximizing kinks are biased upwards. For example, Saez (2010) uses the bunching technique to calculate the elasticity of taxable income at the first EITC kink. Saez reports elasticities of 1.42 and 0.94, respectively, for self-employed taxpayers with one and two or more children during 2000 to 2004. Because this kink maximized refunds for virtually all taxpayers in this group, these figures likely overstate the true elasticities.

More generally, any application of the bunching method may result in biased elasticity estimates in contexts where agents are potentially at global maxima of their objective functions in reporting the variable of interest. Nonetheless, it remains possible to identify conventional elasticities in such contexts if the researcher can distinguish between different modes of behavior. In principle, if one could isolate in the data those agents who behave according to standard bunching models, one could use their observed bunching levels to estimate unbiased elasticities. We have not attempted this, but it remains a potentially fruitful topic for future research.

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