Does Statutory Incidence Matter? Earnings Responses to Social Security Contributions

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Abstract

This paper provides evidence that the statutory incidence of taxes can play an important role in determining the behaviour of taxpayers. Using administrative data for Ireland, we find that short-run earnings responses to social security contributions are stronger when formally levied on employees rather than employers. This is despite both taxes being remitted by employers, and goes against the prediction of standard economic models that predict the irrelevance of statutory incidence.

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1 Introduction

In the canonical competitive labour market model, firms' and consumers' responses to taxes emerge from the relative sizes of the elasticities of supply and demand. As firms have the ability to pass taxes onto consumers through higher prices, it is irrelevant whether taxes are formally levied on the consumer or the producer. In this model, "statutory incidence is not a useful economic concept" (Salanié, 2011).

Recent work has suggested meaningful departures from this 'invariance of incidence' proposition in both labour and product markets. Chetty et al. (2009) find tax-exclusive price labelling increases retailer profitability, and thus that tax salience affects real outcomes. Kopczuk et al. (2016) provide convincing evidence that statutory incidence matters if some agents are better at evasion than others, while Saez et al. (2012) shows that employers compensate workers affected by a cohort-based payroll tax reform for employer but not employee contributions. In a lab experiment, Weber and Schram (2017) find differential extensive-margin labour supply responses to income taxes and dollar-equivalent payroll taxes.

This paper provides a similar point of departure for tax 'notches', thresholds where tax liabilities increase discontinuously. Tax notches have been used extensively to estimate behavioural responses (e.g. Kleven and Waseem, 2013; Sallee and Slemrod, 2012) but with some notable exceptions (e.g. Blinder and Rosen, 1985) less has been done on their theoretical properties.

The first contribution of this paper is to show that the standard theoretical results on statutory incidence need not hold when tax schedules have discrete jumps. In a labour market setting, we show that tax liabilities for wages near notch thresholds differ for payroll (employer) taxes compared to income (employee) taxes. Intuitively, the discontinuous nature of notches creates a region that would generate positive payroll tax liabilities but zero income tax liabilities. This implies a prediction of differential adjustments to employer and employee taxes around notch thresholds.

Secondly, we exploit quasi-experimental variation to test our theoretical

predictions. An ideal experiment to test whether statutory incidence matters would be separate exogenous shifts in the employee and employer tax schedules. Our quasi-experimental environment provides a setting like this. The social security tax schedule in Ireland contains multiple notches which discontinuously increase statutory liabilities on either employees (via decreased pay) or employers (via increased gross costs).

The specifics of this policy facilitate a novel test of the invariance of outcomes to statutory incidence.The social security tax (Pay Related Social Insurance, or PRSI) splits contributions[1] into a portion that "shall be payable [by the] employer", and a portion that will be "to the exclusion of" the employee. These separate schedules face discontinuous notches at different thresholds. For example, crossing a €339 per week earnings threshold in 2007 increased employee contributions by €8.48 per week (€440 per year, 2.5% of income) while crossing a €356 per week threshold increased employer contributions by €8.01 per week (€416 per year, 2.25% of income).

We investigate short-run responses to these notches using administrative linked employer-employee earnings data. Consistent with our model we find clear evidence of earnings responding to this incentive, but only when levied formally on employees. We find very little evidence of earnings responses when the tax is formally levied on employers. Earnings are much more responsive to increases in 'employee taxes' than to comparable increases in 'employer taxes'.

This is striking because in both cases, the tax is remitted fully by the employer. Citing differential ability to evade taxes across the supply-chain, Kopczuk et al. (2016) find tax collections for state diesel taxes increased when the physical requirement of remitting the tax shifted from distributors to wholesalers. In this setting, there is no difference in evasion possibilities between the taxes. Employers calculate the combined employee and employer contributions due and remit this to the tax authority (the Revenue Commissioners). The only difference in who the tax is statutorily incident on: the employee, or the employer.

This is precisely the situation where one might expect that the canonical in-

[1]Section 13(2)(d) of the Social Welfare Consolidation Act, 2005.

variance of incidence result should hold. We show it does not. If tax schedules are discontinuous, as they are with notches, then taxes formally levied on employees does not necessarily result in the same equilibrium as dollar-equivalent taxes on formally levied on employers.

To investigate further, we empirically analyze the determinants of responsiveness. Using the tax return data, we decompose earnings responses to see if behaviour is driven by the characteristics of the employee, of the employer, or both. Self-employment income, or working in the construction sector, for example, are good predictors of reporting a tax-advantaged income. However, we find that these predictors systematically differ between employee- and employer-taxes. A suite of variables are found to be relevant for the employee tax, but only a single predictor — the form of incorporation — is a robust determinant of employer tax responsiveness. Thus earnings are not only less sensitive to employer-focused taxes, they appear to be determined by different factors. Employee characteristics only predict behaviour when the statutory burden falls on that employee.

The most similar paper to ours is perhaps Lehmann et al. (2013) which finds differential responses in France to income taxes than to payroll taxes, suggesting sticky posted wages as a mechanism. We do not rely on market frictions as an explanation but rather show the circumstances when the textbook results do not hold for notches. In an important contribution, Saez et al. (2012) finds firms do not pass payroll taxes onto employees in the manner suggested by the standard theory. More recently, Weber and Schram (2017) finds non-equivalence between payroll and income taxes in a laboratory setting.

The paper carries considerable implications for both policy and the existing literature. From a policy perspective, it highlights the importance of administrative concerns for substantive economic outcomes. To a lesser degree, it provides support for real-world cases where statute formally states the desired legislative effect of taxes. In terms of existing academic work, the paper adds to the growing literature underscoring deviations from classical tax theory results. We believe this is the first time the conditions when statutory incidence applies to tax notches has been formalized. We provide empirical evidence

supporting the result of non-equivalence, and highlight specific ways responses differ between notches on employees and employers.

Section 2 outlines the theoretical component of the paper, formally applying statutory incidence analysis to notches. Section 3 discusses the institutional details of PRSI, with Section 4 providing an overview of the administrative dataset used. Section 5 comprises the empirical analysis which find differential magnitudes of responses and mechanisms underpinning them, while Section 6 concludes.

2 Theory

Economists have known since at least Cournot (1838) that taxes are partly shifted from the remitter to another person in the transaction. The standard incidence results comprise several inter-related predictions: that the identity of the remitter does not affect revenue; that the dollar-value of the tax defines the extent of the response, not whether it is administered on a gross cost or net price basis; and that the elasticities of supply and demand allocate relative burdens (Gruber, 2005). This section outlines the extent to which these results apply to 'notches', discontinuous increases in tax liabilities.

Our focus is whether the result of statutory invariance is robust to administration on a gross cost versus net price basis. To match the empirical section that follows we will focus on a labour market example.[2] We will see that the textbook equilibrium predictions pertain when the tax notch is administered on a gross cost (i.e. payroll tax) basis, but will not in general pertain when calculated/administered on a net pay (i.e. income tax) basis. Intuitively, the discontinuous nature of notches can push net pay below the tax threshold. This implies the standard after-tax predictions do not constitute a well-defined equilibrium, as no tax is due. No such effects occur when the notches are administered on a gross cost basis, as the tax can only increase the gross cost.

Denote W as the gross cost of wages to an employer, and w as the net wage to the employee. Absent taxation, $W = w$. Define a payroll tax t such that

[2]The analysis applies equally to regular commodities.

$W = (1 + t)w$, and an income tax τ such that $w = (1 - \tau)W$.

Proposition 1 If tax liabilities are continuous, the distribution of incidence with a payroll tax t is equivalent to that of an income tax τ where t and τ are isomorphic.

Proof Consider an income tax $\tau > 0$ that relates the net wage of employee w to the gross cost of employment W by the equation $w = (1 - \tau)W$. Taking logs of this equation gives us $\log(w) = \log(1 - \tau) + \log(W)$ which, when differentiated, gives us

$$\frac{dw}{w} = -\frac{d\tau}{(1 - \tau)} + \frac{dW}{W}$$

Using the 'hat' notation as per Fullerton and Metcalf (2002) to define a proportional change e.g. $\hat{W} = \frac{dW}{W}$, we see a relationship between net wage, (net of) tax rates, and gross costs such that:

$$\hat{w} = -\hat{\tau} + \hat{W} \tag{1}$$

Shifting gears slightly, define the elasticity of labour supply $\eta^S = \frac{dL^S/L^S}{dw/w} = \frac{\widehat{L^S}}{\hat{w}}$ which implies

$$\widehat{L^S} = \eta^S \hat{w} \tag{2}$$

Analogously define the elasticity of labour demand $\eta^D = \frac{dL^D/L^D}{dW/W} = \frac{\widehat{L^D}}{\hat{W}}$ which makes it clear that

$$\widehat{L^D} = \eta^D \hat{W} \tag{3}$$

Reaching a new equilibrium implies Equation 2 must equal Equation 3, $\widehat{L^S} = \widehat{L^D} = \eta^D \hat{W} = \eta^S \hat{w}$, and therefore from Equation 1,

$$\begin{aligned} \hat{w} &= -\hat{\tau} + \frac{\eta^S}{\eta^D}\hat{w} \\ &= \left(\frac{\eta^D}{\eta^S - \eta^D}\right)(\hat{\tau}) \end{aligned} \tag{4}$$

and, also from Equation 1, the complementary:

$$\begin{aligned}\hat{W} &= \hat{w} + \hat{\tau} \\ &= \frac{\eta^D}{\eta^S}\hat{W} + \hat{\tau} \\ &= \left(\frac{\eta^S}{\eta^S - \eta^D}\right)(\hat{\tau}) \end{aligned} \tag{5}$$

Now consider a payroll tax $t > 0$ relating gross costs W to net wages by $\frac{W}{(1+t)} = w$. Using the same method that gets us Equation 1, we have

$$\hat{W} = \hat{t} + \hat{w}. \tag{6}$$

which is functionally equivalent to Equation 1. The same results proceed, e.g.:

$$\begin{aligned}\hat{W} &= -\hat{t} + \frac{\eta^D}{\eta^S}\hat{W} \\ &= \left(\frac{\eta^S}{\eta^S - \eta^D}\right)(\hat{t}) \end{aligned} \tag{7}$$

Comparing Equation 5 to Equation 7, we see the equivalence between a payroll tax t and an income tax t. ■

This is the textbook result (e.g. Gruber, 2005) that it does not matter whether the tax is placed on consumers or producers or, in this specific case, as a payroll tax or an income tax. From the starting points of $W = (1 + t)w$ and $w = (1-\tau)W$ note that we can rewrite the problem redefining $\tau \equiv t/(1+t)$ and it is clear that Proposition 1 follows.

Less well-understood are incidence results for notches. Consider a job that pays a wage rate of W_0 prior to the introduction of a notch. Denote as W as the after-tax gross cost of wages to an employer, and w as the after-tax net wage to the employee. Absent taxation, $W = w = W_0$. Now consider a notch threshold, N, exceeding which triggers a lump-sum payroll tax $T_P > 0$. Define an equilibrium as a pair of gross wages (W) and net wages (w) such

that $W - T_P = w$, where

$$\text{Payroll Tax Liability } = \begin{cases} 0 & \text{if } W \leq N \\ T_P > 0 & \text{otherwise} \end{cases}$$

and that these wages $\{W, w\}$ are deviations from W_0 that are consistent with the underlying supply and demand elasticities. Our objective is to determine the equilibrium values of W and w, i.e. the distribution of incidence in the case of notches.

Proposition 2 The distribution of incidence of a notched payroll tax T_P can be expressed in terms of the incidence results of a continuous payroll tax t.

Proof To analyze non-continuous taxes we start with the accounting identity that

$$W = w + T_P$$

The first element of this proof is establishing incidence. The setup here $T_P > 0$ is functionally equivalent to the unit/specific tax analysis in textbooks such as Musgrave (1959). Noting that $W - W_0$ equals the change in wage employers pay, we can derive incidence in terms of the initial wage W_0. Specifically, the after-tax gross cost of employment W will equal:

$$W = W_0 + \underbrace{\left(\frac{\eta^S}{\eta^S - \eta^D} \right)}_{>0} T_P$$

as per Chapter 1 of Salanié (2011) on the incidence of a specific tax. The net

wage (w) is:

$$\begin{aligned} w = W - T_P &= W_0 + \left(\frac{\eta^S}{\eta^S - \eta^D}\right) T_P - T_P \\ &= W_0 + \underbrace{\left(\frac{\eta^D}{\eta^S - \eta^D}\right)}_{<0} T_P \end{aligned} \tag{8}$$

The change in wage $\hat{W} = W - W_0 = w + T_P - W_0$ can then be expressed as:

$$\hat{W} = \left(\frac{\eta^S}{\eta^S - \eta^D}\right) T_P$$

which is equivalent to (a first-order approximation of) Equation 7 ■

An illustrative example here will be useful to compare against the result in Proposition 3.

Example Suppose $W_0 = 105$, $N = 100$, that magnitudes of elasticities of supply and demand are equal (i.e. that $|\eta^S| = |\eta^D|$), and that $T_P = 20$, i.e.

$$\text{Payroll Tax Liability } T_P = \begin{cases} 0 & \text{if } W \leq 100 \\ 20 & \text{otherwise} \end{cases}$$

Equal elasticities imply $\left|\eta^D / \left(\eta^S - \eta^D\right)\right| = \frac{1}{2}$ and so the burden of the tax will be shared evenly. Then $w = W_0 - \frac{1}{2}(T_P) = 95$ and $W = w + T_P = 115$. This represents a coherent equilibrium where the tax is the difference between W and w, and the departures from W_0 are consistent with the underlying elasticities.

Proposition 3 The economic incidence of a notched income tax T_I need not equal the economic incidence of a dollar-equivalent notched payroll tax T_P.

Proof (By contradiction) Suppose $W_0 = 105$, $N = 100$, that magnitudes of elasticities of supply and demand are equal (i.e. that $|\eta^S| = |\eta^D|$), and that

$T_I = 20$.

$$\text{Income Tax Liability } T_I = \begin{cases} 0 & \text{if } w \leq 100 \\ 20 & \text{otherwise} \end{cases}$$

Note the subtle difference between this setup and the example above. In the example, the payroll tax liability T_P is a function $W \leq 100$. Here, the income tax T_I liability is a function of $w \leq 100$.

Equal elasticities again imply the burden of the tax will be shared evenly, and from the example in Proposition 2 $w = 95$ and $W = 115$. However as $w < 100$, from the definition of T_I we see that no tax is due. The absence of tax implies $w \stackrel{!}{=} W$, which is not true under the conditions proposed. This is a contradiction, and the proposed values do not represent a coherent equilibrium. The incidence of T_I differs from the incidence of T_P. ■

We can derive bounds for when the result illustrated in Proposition 3 holds. Consider an initial wage $W_0 \in (N, N + T_I)$. This is where the prevailing wage W_0 strictly exceeds the notch threshold, but not 'by much'. We will show in Proposition 4 that in this situation it matters whether the tax is defined by the gross cost (W) or net wage (w). In the setting where the tax due formula is defined not by the employer cost W but by the employee benefit w, the formula in Equation 8 above ($w = W_0 + \left(\frac{\eta^D}{\eta^S - \eta^D}\right) T_I$) generates circumstances where no tax is due. That is, holding remittance obligations constant, a form of statutory incidence affects real outcomes.

Proposition 4 For any finite and non-zero elasticities of supply and demand $\eta^S, \eta^D \in \mathbb{R}_{\neq 0}$, there are points in the income distribution 'close enough' to a notch threshold N where the incidence of a notched income tax T_I does not equal the incidence of a dollar-equivalent notched payroll tax T_P.

Proof For $W_0 \in (N, N + T_I)$ one of two possible scenarios must prevail. Noting that $W_0 - N$ is how far above the notch threshold the initial wage was, it must be the case that either:

$$W_0 - N > \left| \left(\frac{\eta^D}{\eta^S - \eta^D} \right) T_I \right|$$

or

$$W_0 - N \leq \left| \left(\frac{\eta^D}{\eta^S - \eta^D} \right) T_I \right|$$

In the first case, there is a relatively large gap between the pre-tax wage W_0 and the notch threshold N. In this case it follows from Equation 8 that $w > N$. That implies that even the relatively low price w, the wage that accrues to the worker, is above the notch threshold. In this case the tax is due, and the regular incidence results hold.

However in the second case, there is a relatively small gap between the pre-tax wage W_0 and the notch threshold N. By the same logic from Equation 8 as in the preceding paragraph, $w \leq N$. This means the wage accruing to the worker w, on which the tax is based, falls below the threshold N. No tax is due.

Indeed, for any given elasticities (and thus any given $\left| \left(\frac{\eta^D}{\eta^S - \eta^D} \right) T_I \right| = \delta$) we can find a W_0 close enough to the threshold such that $W_0 - N = \epsilon < \delta$, where the tax is not due. ■

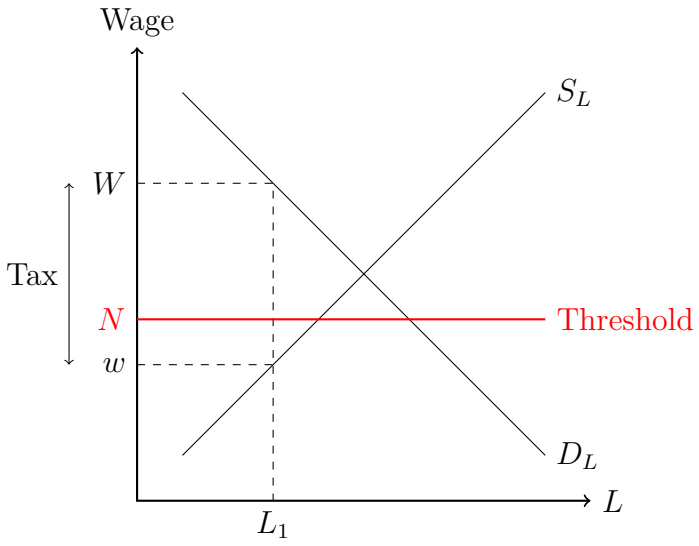
When tax law is statutorily on the employee, there is always a range of pre-tax wages when the laws of invariance do not hold. In the range depicted in the first scenario, where the initial wage is adequately above N, the after-tax wage w remains above the notch threshold and the standard formulae apply.

However in the second scenario, where the initial wage is 'close enough' to N, tax notches can force such a divergence from original prices that the notches are self-defeating in a revenue sense. Intuitively, if the tax wedge pushes the employee benefit below the notch threshold, then no tax is due. In this case, the standard formulae do not generate a coherent equilibrium. This is the key difference between discontinuous taxes (notches) and the usual ad valorem incidence results we find in textbooks. Notches' discontinuous nature are different.

We can provide the intuition of the result with a graphical analysis. See Figure 1 below. It depicts a standard market equilibrium with a tax.

Without a notch, the equilibrium is quantity L_1 with a wedge between gross

Figure 1: Graphical depiction of the result



wages and net wages equal to the amount of the tax. The notch threshold at N changes the analysis. If the tax is levied on the employer-side (W), then the price is above the notch threshold, and the textbook case prevails. If the tax is levied on the employee's side of things, then the relevant price (w) is below the threshold and the tax is not due. For any notch and elasticities, there are wages close enough to the cut-off point that the net wage is below the threshold.

Absent the standard equilibrium conditions pertaining, it is natural to ask what predictions can be made. In this second scenario, where tax liability is statutorily on the employee-side and where wages are only slightly above the notch threshold, mutually beneficial (Pareto improving) agreements/bargains exist for the employee and employer. The most obvious such bargain is where gross wages adjust to just avoid the tax, i.e. $w = W = N$. Relative to the case where a tax must be paid, this bargain would leave both employer and employer better off.[3]

Note the crucial distinction between when the tax increases gross costs versus decreases net pay. In the gross cost case and in the net pay case where

[3]Of course, this is just one such agreement from a class of potential agreements.

wages are far above the notch, the standard incidence results constitute a coherent equilibrium. Although mutually beneficial bargains may still exist, the standard equilibrium results are a reasonable starting-point for predicting behaviour. However, in the net pay case when the wage is close enough to the notch threshold, the standard equilibrium will not pertain. The distribution of after-tax burdens predicted by standard economic theory simply does not hold, as no tax is owed. We thus do not expect equivalent adjustments in the net pay (Employee notch) case as the gross cost (Employer notch) case. To the extent that markets tend to adjust to equilibrium conditions, we expect the gross cost case to adjust as standard theory predicts, but expect 'new' adjustment behaviour (such as the Pareto-improving bargain $w = W = N$) to occur in the net pay case.

The empirical analysis that follows tests these predictions. We will first investigate whether earnings responses differ between the gross cost and net pay cases. As discussed above, the responses do differ: we will see clear evidence of responsiveness only in the net pay case. To shed light on mechanisms we will then analyze the determinants of earnings response, and test if they are consistent across tax types.

3 Institutional Details

Social security in Ireland is funded primarily funded through the Pay Related Social Insurance (PRSI) system. PRSI is a tax with legal obligations on both employees and employers to contribute. Contributions entitle workers to a number of benefits such as increased unemployment insurance. Eligibility for these benefits is based on the duration that the tax is paid, rather than the number of euros paid. Thus, although taxes increase with income, because PRSI is largely an 'in or out' system, benefits are essentially independent of income. In this respect PRSI has elements of redistribution between workers rather than an actuarially fair insurance system.

The legislation specifies the shares of total contributions ("statutory incidence") that are to be borne by the employer and the employee. Section 13 of

the Social Welfare Consolidation Act states:

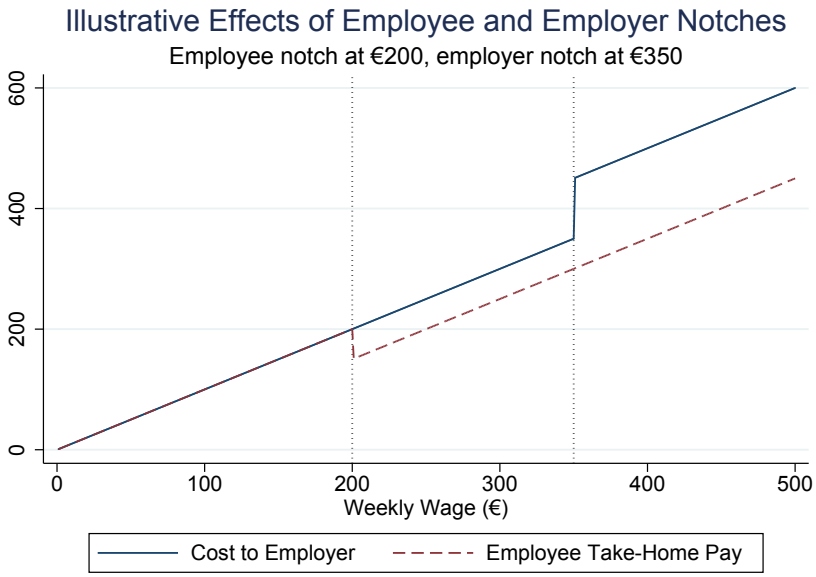
> *The employer shall, in relation to any employment contribution, be liable in the first instance to pay both the employers contribution comprised therein and also, on behalf of and to the exclusion of the employed contributor, the contribution comprised therein payable by the contributor.*

This legal text asserts that remittance of both employer and employee contributions is the responsibility of the firm, but that the firm may subtract the employee contribution from gross wages. The implication is that the employee contribution is administered as a reduction in the worker's net pay while the employer contribution, which has a separate schedule of rates, is to be added to the firm's gross costs.

Like most social insurances taxes the PRSI system is progressive, with marginal rates increasing as income crosses thresholds from one weekly pay band (or "subclass") to another. Two unique features of this system are at the heart of this paper, however. Firstly, crossing these thresholds does not just increase marginal rates, but also triggers substantial lump sum liabilities. These discrete jumps in tax liability — what the literature commonly calls 'notches' — provide extremely strong incentives to report earnings just below these thresholds. Following Saez (2010) and Chetty et al. (2011), a large literature has investigated the extent to which agents 'bunch' near these thresholds. The amount of bunching, the excess mass of agents reporting incomes just below these thresholds relative to just above, reveals the extent of the responsiveness of taxpayers to the tax (Kleven and Waseem, 2013). Bunching estimators can be used to infer the elasticity of earnings, with the extent of the bunching positively related the elasticity of earnings.

Secondly, these notches apply differentially to the employee and employer shares of total PRSI contributions. That is, statute not only induces these notches, but also specifies whether the notch should be administered through an increase in gross costs (employer contribution) or through a decrease in net pay (employee contribution). Figure 1 illustrates a hypothetical example

Figure 2: Graphical depiction of accounting effects of hypothetical €50 employee and €100 employer notches.



of the effects of this differential treatment. The figure shows the relationship between wage payments made by an employer and the take-home pay of the employee. At an employee notch, which in the figure is located at €200, the take-home pay of the employee drops by the amount of the tax (€50), but the cost to the employer is unaffected. In contrast, the notch at €350 sees the cost to the employer increase by the amount of the tax (here, €100) but does not change the net pay of the employee. Of course this scenario depicts an accounting exercise, not behavioural responses.

The experimental design of this paper relies on the fact that the notched element of these thresholds apply differentially to the employers' tax and the employees' tax. In particular, this paper will investigate if responsiveness differs between employee notches and employer notches. The null hypothesis motivated by standard theory is that statutory incidence does not affect behaviour. Of course the prediction of Section 2 is that there will be a greater response to taxes based on reductions in net pay.

The full list of notches and liabilities associated with them is outlined in

Table 1.

Table 1: Outline of notches and tax penalties for crossing threshold

	AX (Employee)		*AL (Employer)*	
Year	Threshold	Notch amount	Threshold	Notch amount
2005	287	6.40	356	8.01
2006	300	6.92	356	8.01
2007	339	8.48	356	8.01
2008	352	9.00	356	8.01
2009	352	9.00	356	8.01

An example helps clarify the information presented in this table. In 2007, earning €0.01 over €339 per week (€17,628 per year) pushed an employee into "Subclass AX". This increased the PRSI marginal tax rate from 8.5% to 12.5%, but more importantly triggered a €8.48 per week (€440 per year) lump-sum penalty in the employee share. Notice that the tax increase applied to the employee share. The legal requirement of the firm was to implement this tax through a decrease in net pay. In accounting terms, their gross costs were entirely unaffected.[4]

In contrast, earning anything above €356 per week (€18,512 per year) pushed an employee into "Subclass AL". This increased the PRSI marginal tax rate from 12.5% to 14.75%, and triggered an €8.01 per week (€416 per year) lump-sum penalty — but this time on the employer share. That is, unlike the previous example, the statutory incidence of this threshold fell entirely on the firm. In legal terms, this tax was to be paid through an increase in gross costs, not a reduction in net pay.

Standard Marshallian analysis would suggest that the statutory incidence of these notches should have zero impact on the behaviour of firms. In the Marshallian framework, the equilibrium will be an adjustment of prices and quantities independent of whether the tax is accounted as an increase in gross cost or as a reduction in net pay. The theoretical analysis in Section 2 showed

[4]Beyond the notional increase in liability from a 1 cent pay increase, of course.

that this does not hold in the neighbourhood of notches, and additional 'new' adjustment behaviour is expected for the net pay case.

4 Data Description

The data in this paper are an administrative panel of employee tax returns for Ireland, with access provided under a confidentiality agreement with the Central Statistics Office (CSO). CSO acts as an intermediary for collating relevant data from various state agencies. The primary source are tax returns from the Irish Revenue Commissioners. These data contains the details from the P35 tax form. This is comparable to a W-2 in the United States in that it is the firm's statement of payments made to an employee, and the amount of tax withheld and remitted to the IRS. This is an advantage of the dataset, as it is income reported by a third-party (the employer, who faces additional legal ramifications for mis-reporting) rather than data populated by the employees themselves. Self-employed people are subject to self-assessment. The income figure is formally called "Taxable Pay". The P35 form includes both the firm's ID and the individual's social security number, and with these CSO merges in firms' form of incorporation and four-digit industrial sector; the year of birth, sex, and nationality of individuals; and firms' number of employees, number of hires, and number of separations. The data come in the form of a random sample of 10% of all individual tax returns, which are reported by the employer annually. It is a representative sample of the universe of workers.

Two variables generated from the dataset are the employee and employer "dominated regions" dummy. Consider an employee who faces an additional €8 tax liability by earning one cent above a certain notch threshold. It should be immediately clear that the employee is strictly better off reporting earnings just below that threshold than by earning any income in the range of the threshold and €8 above. Earning in the region is clearly in a tax disadvantaged portion of the income distribution. We thus define the dominated region dummy variable equal to one if the employee reports an income in that €8 interval. Earning below that threshold is a tax-advantageous income. We define, somewhat

Table 2: Summary statistics from administrative data sources

Variable	Obs	Mean	Std Dev	Min	Max
Employee Dom. Region	27,326	0.65	0.48	0	1
Employer Dom. Region	28,119	0.76	0.43	0	1
Age	934,171	35.59	12.71	16	85
Irish	934,171	0.67	0.47	0	1
Male	934,171	0.47	0.50	0	1
EU 2004	934,171	0.14	0.35	0	1
52 weeks	934,171	0.46	0.50	0	1
Construction industry	934,171	0.07	0.25	0	1
Hotels and Restaurants	934,171	0.11	0.32	0	1
Public Sector	934,171	0.19	0.39	0	1
Agriculture	934,171	0.02	0.13	0	1
Public body	934,171	0.10	0.30	0	1
Sole Proprietorship	934,171	0.13	0.33	0	1
Any self-employment income	934,171	0.03	0.18	0	1

arbitrarily, reporting a tax-advantaged income as earning within €3 of the threshold per week without crossing it. Formally,

$$\text{Dominated Region} = \begin{cases} 1 & \text{if income in dominated region} \\ 0 & \text{if income} \in \text{(Threshold-€3, Threshold]} \end{cases}$$

The dominated region variable is generated analogously for the employer notch. Though analogous, it is important to important to note a subtle difference between the clearly-dominated region from the employee's perspective and the likely-suboptimal region from the employer's perspective. Due to the increased tax liability, an employee whose earnings are just above the notch threshold is substantially more expensive than the same worker who simply works marginally fewer minutes. It seems unlikely that the marginal product of the worker is high enough to recoup the additional hundreds of euro in taxes in those few minutes. Though unlikely, we cannot say with certainty that this represents suboptimal behaviour on the part of the employer. Without knowledge of the firm's costs, it is possible this is still profitable for the firm if the marginal product of labour is extremely high. For convenience we ignore

this possibility and continue to refer to crossing this threshold as suboptimal behaviour.

5 Empirical Analysis

The primary empirical question in this paper is whether taxpayer behaviour depends on whether the tax statutorily falls on the employee or the employer. This question is teased out in three separate approaches below.

Firstly, we investigate the extent of bunching just below the thresholds. This approach, pioneered by Saez (2010) and others, measures if there exists excess mass of earnings just below the notch thresholds. We will do this both in terms of the absolute number of people reporting earnings at the threshold and in terms of changes in the number. The latter is a method to alleviate concerns about a preference for round-numbers. As alluded to above, we do indeed find differential responses between employee notches and employer notches.

Secondly, to investigate potential channels to explain the different levels of avoidance, we investigate whether the characteristics of bunchers differ significantly from those who do not. This approach comprises regressions predicting whether an individual reports earnings just above versus just below a notch threshold. We find that the determinants (e.g. nationality, age, sector, firm size) of earning just below the threshold are different from those just above, as expected.

Thirdly, we will compare these determinants across notches. We will find that employee characteristics (e.g. age, nationality, any self-employment income) are predictors of employee-focused notches, but not employer-focused notches. The dataset spans from 2006–2013 but large reforms introduced the Universal Social Charge in 2010 which affected PRSI structures. Furthermore notes Hargaden (2018) overall taxpayer responsiveness declined considerably during the recession. Consequently, we focus our attention on a tight window of 2006–2009 to minimize the effect of cyclical changes or policy reforms on behaviour.

5.1 Bunching estimates

Our first empirical analysis on statutory incidence investigates if the extent of bunching differs between employee and employer notches. The work on bunching near kink/notch thresholds is now very large, for example Ramnath (2013), Bastani and Selin (2014), Kleven and Waseem (2013), Saez (2010), Sallee and Slemrod (2012), Best and Kleven (2018), Onji (2009), Mortenson and Whitten (2015).

Below we plot figures of the income distribution near the notch thresholds. In particular, these figures represent the weekly earnings in €2 bins for each year of our analysis. The solid red line represents the threshold for crossing into Subclass AX, which causes a discrete jump in employee contribution. We thus call this the Employee notch. The dashed green line is at the threshold for Subclass AL, crossing which triggers an increased liability for the employer, and thus we call this the Employer notch.

Figure 3: Excess bunching graph in the first full year of data

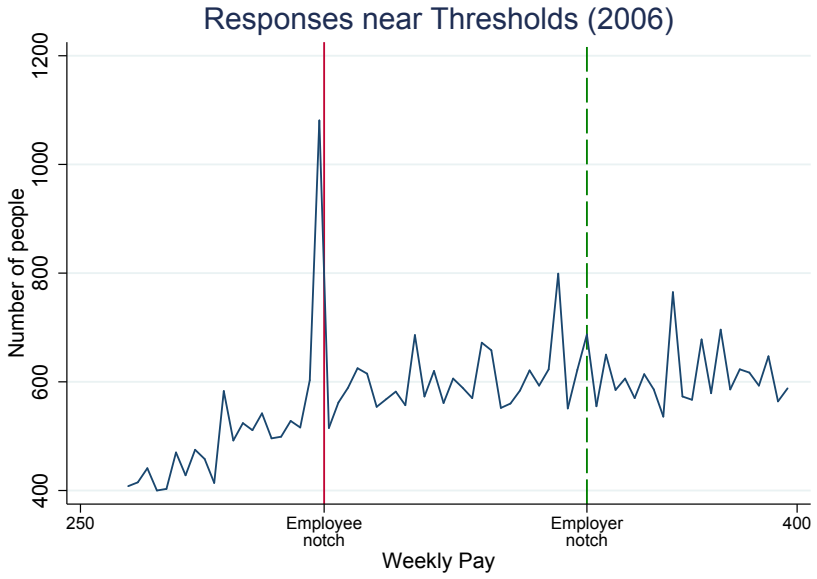


Figure 3 shows large spikes, or bunching, at several points in the income distribution. There is clear evidence of bunching just below the employee notch.

We approximately 1100 people reporting an income that avoid the penalty associated with crossing that threshold, whereas the income distribution would suggest closer to 500 would be expected to earn within that €2 band, implying an excess mass of approximately $1100 - 500 = 600$ people responding to the tax incentives. Similarly, we see a considerable (but smaller) spike to the left of the employer notch, with approximately $800 - 600 = 200$ more people apparently reporting earnings just below the threshold than would be expected looking at comparable bins.

Figure 4: Bunching (Levels)

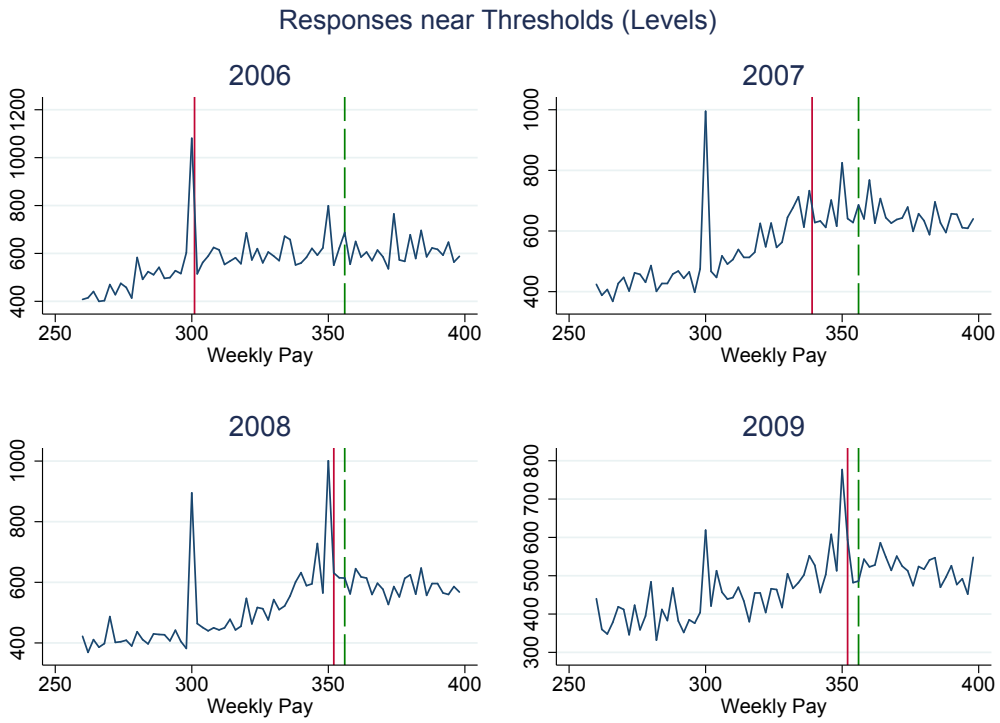


Figure 4 shows bunching graphs for all years between 2006 and 2009 inclusive. The results are weak for 2007, but quite striking for 2008. In that year, the AX and AL notches converged to within €4 per week of each other. In this case, both the employer and employee could lower that statutorily defined contribution with a relatively small adjustment in earnings. It is thus not sur-

prising that we see a large response to the notch thresholds in this year. This effect persists in 2009, as demonstrated in the bottom right-hand panel.

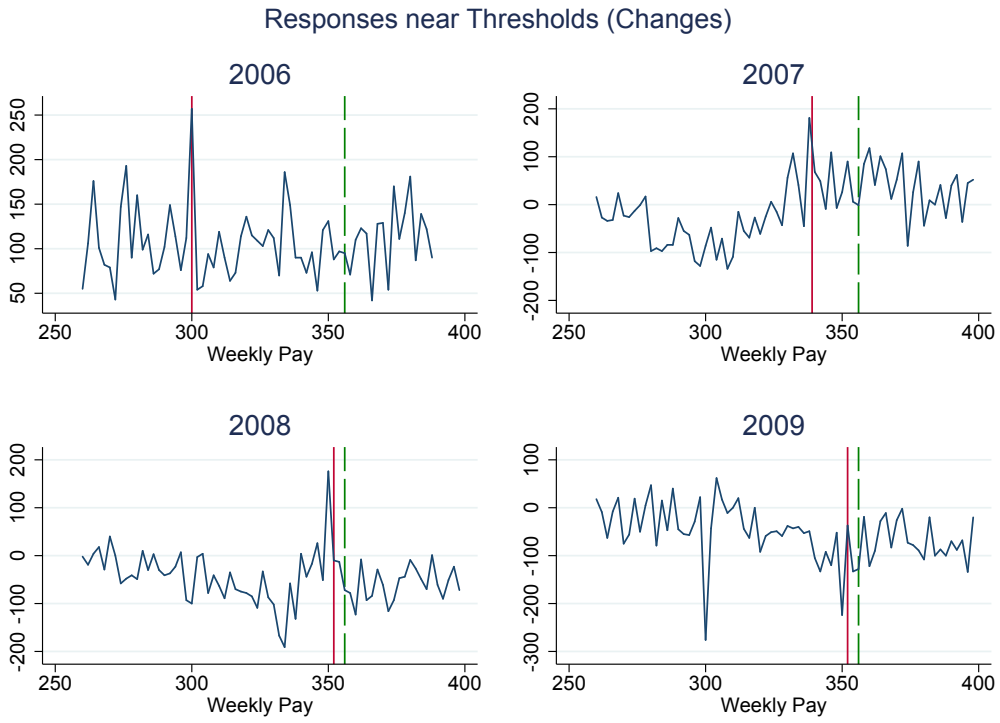
However, it is impossible with this approach to compellingly disentangle tax-inspired bunching from round-number bunching when looking at figures like those above. For example, the large spike at €300 could be simply a preference for paying in multiples of one hundred. To overcome this confounding problem, we employ a different identification strategy. In contrast to Figure 4, the panels below use a difference-in-bunching estimator. This approach combines the benefits of the bunching estimator with a difference-in-differences framework. Rather than plot the level (or number) of people in a particular income bin, the difference-bunching estimator looks at the change in the number of people in that income bin. Of course, just like regular differencing techniques, this approach comes at the cost of us losing the initial time-period's observation.[5] Figure 5 demonstrate the bunching in differences rather than levels. Absent changes in the size of the labour force, the difference-bunching estimator should be mean zero. The implication of this approach, somewhat like difference-in-differences, is that any deviations from zero near tax thresholds are attributable to the tax avoidance and not round-number bunching.

In 2007 we see a spike of (approximately 180) people responding to the tax treatment. This is a cleaner form of identification for the tax effect, as opposed to a round number effect. The identification assumes that the taste for round numbers is constant through time. Conditional on the taste for round numbers not shifting between 2006 and 2007, we can attribute these changes to tax incentives. Notice that unlike the bunching evidence in levels, we do not see much of a reaction for the employer threshold in 2007. We conclude that what was previously interpreted as a tax effect is better considered a round number effect.

In 2008, when the notches are only €4 apart, we see yet another large spike in extra people (this time close to 200) responding to the tax incentives. This

[5]For this paper, that year is 2005. Although not strictly included in the dataset, previous year's earnings are available for the 80% of workers are continue employment with the same firm in both 2005 and 2006. The differences graphs for 2006 are calculated using this subsample.

Figure 5: Bunching-in-Differences



is quite strong evidence, and it occurs when a single small response could avoid both employer and employee tax notches. However the spike of approximately 200 people above expectations is only of the same magnitude as at the employee spikes in 2006 and 2007. That is, there is little evidence of additional bunching when the employer notch is also relevant. Specifically, this is consistent with a simple continuation of employee tax-oriented responsiveness.

We see little evidence of responsiveness in 2009 when the recession hit Ireland's labour market. This result mimics the findings of Hargaden (2018), which finds substantial cyclicality in responsiveness at other notches in the Irish income tax system.

5.2 Determinants of Bunching

Given that we observe differences in the extent of bunching between employee and employer notches, it is pertinent to ask what is driving it. Who is doing the bunching? Is it possible to decompose the determinants of responsiveness into sensible predictors? For example, are workers in cash-based industries such as construction better at avoiding taxes than equivalent workers whose pay comes directly from government? Such analysis has been done before in other countries, e.g. Slemrod et al. (2001), Advani (2017). However these studies are based on ex post audits of tax returns, whereas this analysis is predicting avoidance behaviour separately for employee- and employer-targeted notches.

Inspired by the determinants found in Slemrod et al. (2001) and Advani (2017), we focus analysis on a list of plausible predictors of reporting a tax-advantaged income. We start with a relatively large list of covariates and will later use techniques developed by Belloni et al. (2014) to narrow the list down. These initial variables are listed in Table 3 and are broken down by whether the characteristics relate to the employee or employer. Summary statistics were presented in Table 2 above.

Table 3: Suite of potential determinants of tax avoidance

Individual Characteristics	Firm Characteristics
Age	Construction sector
Sex	Agriculture sector
Irish citizen	Hospitality sector
EU-2004 citizen	Public Sector
Any self-employment income	Sole-proprietorship
Same-firm 52 weeks a year	Public body

The variables are age, sex, Irish national, national of the EU 2004 accession states, a dummy for any self-employment income, a dummy for whether the individual worked for the same firm for fifty-two weeks of the year, construction, agriculture, hotels and restaurants, and public sector dummies, the legal form of incorporation of the firm (sole-proprietorship or other), and a dummy variable for whether the employer is a semi-state company. The majority of

these indicators are self-explanatory, but some may require justification. Sex is included earlier studies have found women have more elastic labour supply responses than men (Bargain et al., 2014). The base category for citizenship is non-Irish/non-EU 2004 citizen, the majority of which are UK citizens. The prior expectation is that Irish citizens have better knowledge of the tax code than UK citizens, and that citizens of newly admitted EU countries (who are almost certainly recent migrants to Ireland) have less knowledge. The base category for industry is retail; it is expected that cash-based sectors like construction will have less tax compliance (and thus more avoidance) than retail, and that public sector bodies will have less responsiveness to tax incentives.

Following Hargaden (2018) we suspect the flexibility of labour market conditions (such as the availability of overtime hours) could vary over the business cycle, and thus we want to be sure the determinants are similar in the early periods (2006–2007) and the Great Financial Crisis recessionary period (2008–2009). The analysis of Tables 4 and 5 test this, by estimating regressions for the early 2006–2007 period and for the complete 2006–2009 period. The first table of results shows the coefficients from an OLS regression on whether an individual reports an income below ($Y = 0$) or above ($Y = 1$) the relevant threshold. The first column of results relates to the employee notch, and the second to the employer notch. Unsurprisingly, given our finding of more bunching at the employee notch, the predictors of responding to this notch appear more significant than the employer notch.

The most significant predictors for the AX notch are working for the same firm fifty-two weeks of the year (about 4.8% less likely to cross threshold), working in the construction sector (also less likely, by 7%), working in the public sector (7.7% more likely), working for a sole-proprietorship (13% less likely), and having self-employment income (8.6% less likely). Reassuringly, the signs on the coefficients across specifications are comparable, e.g. working fifty-two weeks of the year (usually a pre-condition for being salaried) lowers the probability of paying the AX (employee) tax by 4.8% and the AL (employer) tax by 3.2%. However, there is less significance for the employer specification than for the employee. This is not surprising, as we have already noted that

Table 4: Determinants of reporting above notch thresholds, 2006–2007

	(1) Employee (AX) notch	(2) Employer (AL) notch
Age (Decade)	-0.0070	-0.014**
	(0.0052)	(0.0049)
Irish	0.0048	0.017
	(0.016)	(0.015)
Male	-0.011	-0.011
	(0.013)	(0.011)
EU 2004	0.035	0.027
	(0.019)	(0.017)
Fifty-two weeks	-0.048***	-0.032**
	(0.014)	(0.012)
Construction sector	-0.070**	0.027
	(0.022)	(0.020)
Hotels & Restaurants	0.00019	-0.011
	(0.017)	(0.015)
Public Sector	0.077***	-0.012
	(0.021)	(0.019)
Agriculture	-0.025	0.00073
	(0.044)	(0.041)
Public Body	0.022	0.051*
	(0.029)	(0.026)
Sole-proprietorship	-0.13***	-0.027
	(0.015)	(0.015)
Self-employment income	-0.086*	-0.15***
	(0.044)	(0.038)
Constant	0.72***	0.77***
	(0.024)	(0.022)
Year FEs	Yes	Yes
Observations	6,503	7,195
Adjusted R^2	0.037	0.007

there appears to be greater manipulation around the employee notch.

Table 5 presents a similar picture to Table 4, but this time the period of interest is expanded to include the whole 2006–2009 period. As the regressions in Table 5 have approximately twice as many observations as in Table 4, it is not surprising that the likelihood of discovering a statistically significant result in increased. What is crucial is that the marginal effects are not markedly different through time. For example, the statistical significance of the estimated effect of working in the construction sector has changed from the 5% level to the 1% level, but the coefficient change (from -0.07 to -0.088) is within one standard deviation and so the conclusions from the first column in Table 5 continue the narrative from Table 4. We find although many variables are insignificant, certain individual characteristics (e.g. nationality, number of weeks worked, any self-employment income) and firm characteristics (e.g. sector, and form of incorporation) are good predictors of tax avoidance behaviour. Further, we find less statistically significant results on the employer side.

5.3 Seemingly Unrelated Estimation

The evidence presented above suggest that the mechanisms for greater responsiveness are different for employer and employee taxes. However, it is plausible that the statistical insignificance could be driven by having too many explanatory variables in the regression. Just as there is an argument for including a full suite of variables when trying to understand the determinants of tax avoidance, there is an argument to be made for keeping regression equations parsimonious. The search for 'robust determinants' of behaviour is particularly appropriate if one is comparing across different outcomes: how sensitive are the results to the variable selection method? Thus in addition to the determinants shown above, we also exploit the lassoShooting procedure in Stata to apply the Double-Lasso method (Belloni, Chernozhukov and Hansen, 2014; Urminsky, Hansen and Chernozhukov, 2016). The Double-Lasso method, as suggested by the name, is a LASSO estimator that iterates through multiple possible specifications until it settles on what it considers the 'best' set of co-

Table 5: Determinants of reporting above notch thresholds, 2006–2009

	(1) Employee (AX) notch	(2) Employer (AL) notch
Age (Decade)	-0.0030	-0.015***
	(0.0035)	(0.0035)
Irish	0.017	0.011
	(0.011)	(0.011)
Male	-0.014	-0.0082
	(0.0086)	(0.0082)
EU 2004	0.047***	0.021
	(0.012)	(0.012)
Fifty-two weeks	-0.039***	-0.0088
	(0.0089)	(0.0086)
Construction	-0.088***	0.017
	(0.015)	(0.015)
Hotels & Restaurants	-0.0100	-0.017
	(0.011)	(0.011)
Public Sector	0.069***	-0.022
	(0.014)	(0.013)
Agriculture	-0.076**	-0.0079
	(0.029)	(0.030)
Public Body	-0.0027	0.061**
	(0.020)	(0.019)
Sole-proprietorship	-0.14***	-0.012
	(0.011)	(0.011)
Self-employment income	-0.11***	-0.11***
	(0.027)	(0.028)
Constant	0.70***	0.80***
	(0.018)	(0.017)
Year FEs	Yes	Yes
Observations	13,994	13,515
Adjusted R^2	0.036	0.005

variates. This approach isolates the variables that provide the most robust statistical significance given an atheoretic/flexible approach to prediction.

Table 6: Double-Lasso variable selection, Employee (AX) notch

Variable	Post-Lasso Marginal Effect
Male	-.0206
EU 2004	.0395
Construction sector	-.0632
Public sector	.0371
Sole-proprietorship	-.1920
Self-employment income	-.0924

Table 7: Double-Lasso variable selection, Employer (AL) notch

Variable	Post-Lasso Marginal Effect
Sole-proprietorship	-.0379

Table 6 shows the covariates chosen by the Double-Lasso method as the most robust predictors of the Employee (AX) notch, and their associated marginal effects. We can see that both the signs and coefficients on the variables are consistent with this suggested by the Linear Probability Model, for example the construction sector indicating about a 6.3% decrease in the probability of crossing the notch threshold. We can also see that Double-Lasso, a flexible approach that is not driven by theoretical priors, focuses in on six variables to predict employee responses. These variables include both characteristics of the individual (e.g. sex, nationality) and also characteristics of the firm (e.g. sector, form of incorporation).

Table 7 performs the identical procedure as Table 6 but on the Employer (AL) notch. It is immediately apparent that the variable selection varies enormously from that suggested in Table 6. Unlike the results there, which indicate a relatively large number of variables (both firm-based and employee-based) that predict responsiveness to the notches, Table 7 suggests that only a single variable — the form of incorporation (sole-proprietorship vs. other) —

robustly predicts responsiveness. No characteristic of the individual, such as nationality or even their self-employment status, predicts reporting earnings below the notch threshold. The channels by which avoidance occurs differs between employee- and employer-focused incidence.

The fact that predictor variables differ between employer- and employee-taxes provides initial evidence that mechanism of avoidance differ between employers and employees. However, what about the determinants of response in a pooled sample? Taking both AX and AL notches together, does the Double-Lasso method provide a sensible variable selection algorithm? Tables 8 and 9 investigate this. Firstly, Table 8 presents regression results on the pooled AX and AL sample, and also on a larger sample that includes other notches. As a major focus of this paper is the effect of statutory incidence, these additional notches (A1 and S subclasses) are not directly comparable to the AX and AL notches. However, if we are simply finding robust determinants of responsiveness, then including these notches improves the precision and power of our estimates.

Applying the Double-Lasso method on this broader set of notches that includes over 60,000 observations, we find a similar set of robust determinants of earnings response. In particular, the variables include both individual characteristics (age, and self-employment status) and firm characteristics (sector, and form of incorporation) as the strongest predictors of response. As this list of variables is chosen from the largest set of notches, we proceed with some further analysis taking the choice of these variables as the 'best' predictors of tax avoidance.

With this set of 'best' predictors, we now re-run the determinants of crossing the AX (employee) and AL (employer) thresholds with these predictors as covariates. Tables 10 and 11 are similar regressions to those presented earlier, but with two key differences. Firstly, the set of covariates is determined algorithmically by the Double-Lasso operator on the full set of available notches. Secondly, the tables include an explicit test of whether the coefficients in these regressions systematically differ from each other. These is achieved via Seemingly Unrelated Estimation. This procedure is comparable to a Hausman test

Table 8: Determinants of reporting above various notch thresholds

	(1) AX or AL	(2) AX, AL, A1, or S
Age (Decade)	-0.0081***	-0.0067***
	(0.0020)	(0.0017)
Irish	0.0087	0.0082
	(0.0063)	(0.0052)
Male	-0.0073	0.0000033
	(0.0049)	(0.0041)
EU 2004	0.036***	0.026***
	(0.0073)	(0.0062)
Fifty-two weeks	-0.017***	-0.0036
	(0.0050)	(0.0041)
Construction	-0.029**	-0.035***
	(0.0098)	(0.0079)
Hotels & Restaurants	-0.019**	-0.031***
	(0.0066)	(0.0059)
Public Sector	0.018*	0.021***
	(0.0076)	(0.0064)
Agriculture	-0.044**	-0.048**
	(0.017)	(0.015)
Public Body	0.029**	0.037***
	(0.011)	(0.0087)
Sole-proprietorship	-0.13***	-0.12***
	(0.0067)	(0.0058)
Self-employment income	-0.088***	-0.13***
	(0.015)	(0.011)
Constant	0.78***	0.76***
	(0.011)	(0.0096)
Year FEs	Yes	Yes
Observations	43,119	60,279
Adjusted R^2	0.037	0.028

Table 9: Double-Lasso variable selection, any notch

Variable	Post-Lasso Marginal Effect
Age (decade)	-.0088
Public Sector	.0270
Public Body	.0370
Sole-proprietorship	-.1190
Self-employment income	-.1434

comparing fixed effects models to random effects models. In the Hausman test, one checks if the coefficients in the different models are systematically different and thus if the RE model varies from the FE model. Here, we start in Table 10 by checking if the pre-recession AX coefficients are different from the 2008–2009 coefficients. The test is summarized by the χ^2 statistic displayed towards the bottom of the table, with its associated p-value. A high χ^2 (and thus low p-value) would reject the null of equivalent coefficients over the two time periods.

Tables 10 and 11 demonstrate that the robust, flexibly-selected determinants of crossing any notch are consistent, within notch, over time. Table 10 shows the determinants for the Employee AX notch in both the pre- and during-recession periods, and although the coefficients are not identical, there is not much evidence from the χ^2 that the determinants are systematically different, namely a p-value of 0.34 fails to reject a null that the determinants are statistically equivalent. Table 11 presents comparable information for the Employer AL notch. Again, the determinants are largely similar in both direction and magnitude, and a formal test of equivalent coefficients is not rejected ($p = 0.36$). These null results are reassuring, as there does not seem to be systematic differences within notches through time. The structural relationship appears consistent regardless of the time period.

However, we can also test whether the coefficients from Tables 10 and 11 are different from each other. Just as we found that the variables chosen by the Double-Lasso method differed between notches, testing if the coefficients between Tables 10 and 11 are different is inherently a test of whether the

Table 10: Determinants of crossing AX threshold on Lasso-selected variables, by time period

	(1) 2006 and 2007	(2) 2008 and 2009
Age (Decade)	-0.012*	-0.0023
	(0.0049)	(0.0046)
Public Sector	0.084***	0.076***
	(0.020)	(0.018)
Public Body	0.016	-0.032
	(0.029)	(0.028)
Sole-proprietorship	-0.14***	-0.18***
	(0.015)	(0.015)
Self-employment income	-0.12***	-0.16***
	(0.043)	(0.033)
Constant	0.72***	0.70***
	(0.017)	(0.017)
Year FEs	Yes	Yes
Observations	6,503	7,491
Adjusted R^2	0.033	0.023
χ^2 on null of equivalent determinants	5.68	
p-value	0.34	

determinants of responsiveness differ between notches. As above, this procedure will produce a test-statistic that follows a χ^2 distribution. The results overwhelmingly reject the null of equivalent coefficients. Comparing within-notch coefficients produced test-statistics around 5.5 and p-values around 0.35. Comparing between-notch coefficients produces a test-statistic of 218.4 and a p-value of less than 0.0000: the determinants are hugely different. Even when using the list of variables algorithmically chosen from a large set of notches, the channels that determine earnings responses are enormously different between the employee-notch and employer-notch.

Table 11: Determinants of crossing AL threshold on Lasso-selected variables, by time-period

	(1) 2006 and 2007	2 2008 and 2009
Age (Decade)	-0.018***	-0.014**
	(0.0046)	(0.0048)
Public Sector	-0.012	-0.028
	(0.019)	(0.018)
Public Body	0.048	0.074**
	(0.026)	(0.028)
Sole-proprietorship	-0.024	0.0074
	(0.014)	(0.016)
Self-employment income	-0.16***	-0.062
	(0.038)	(0.040)
Constant	0.79***	0.80***
	(0.016)	(0.018)
Year FEs	Yes	Yes
Observations	7,195	6,320
Adjusted R^2	0.006	0.003
χ^2 on null of equivalent determinants	5.44	
p-value	0.36	

6 Conclusion

This paper provides theoretical and empirical evidence that statutory incidence matters in ways not previously thought. We investigate incidence for tax notches, discontinuities in schedules which are "ubiquitous across a wide range of tax and nontax settings" (Kleven, 2016). We show that the textbook incidence results do not hold for the case of notches.

For notches, taxes on net pay differ from dollar-equivalent taxes on gross costs. When notch thresholds are defined by the employee net pay, there can be no seamless transition to the standard equilibrium because those conditions do not constitute an equilibrium. Absent this default transition, both sides of the market can improve outcomes by adjusting earnings to avoid taxes.

Economists have arguably been too quick to assume the generality of clas-

sical results on statutory incidence. A growing literature has provided considerable empirical evidence questioning the applicability of these results. Chetty et al. (2009) introduced the importance of tax salience; Saez et al. (2012) found firms were reluctant to treat young and old workers differently; Lehmann et al. (2013) suggest sticky wages mitigate equilibrium responses; and Kopczuk et al. (2016) found differential evasion possibilities imply incidence is a function of the remitter. We show that incidence matters when tax schedules contain discontinuities.

Exploiting a natural experiment in Ireland where notch thresholds differ for employee and employer contributions to the social insurance tax, we find earnings respond to both employer-focused and employee-focused taxes, but not equivalently. There is a stronger response to taxes that are statutorily placed on the employee. Decomposing the earnings response by characteristics of the employer and characteristics of the employee, we find a statistically significant difference in the drivers of responsiveness. Although both the employer- and employee-earnings response seem consistently stable, with little empirical support for inter-temporal effects, there is overwhelming evidence that the responses are different between employer taxes and employee taxes. As deadweight losses are functions of behavioural responses, policymakers wishing to minimize the distortions from taxation should place statutory incidence at the level that minimizes response.

References

Advani, Arun, "Who does and doesn't pay taxes?," *Institute for Fiscal Studies Briefing Note*, 2017.

Bargain, Olivier, Kristian Orsini, and Andreas Peichl, "Comparing labor supply elasticities in europe and the united states new results," *Journal of Human Resources*, 2014, *49* (3), 723–838.

Bastani, Spencer and Håkan Selin, "Bunching and Non-Bunching at Kink Points of the Swedish Tax Schedule," *Journal of Public Economics*, January 2014, *109*, 36–49.

Belloni, Alexandre, Victor Chernozhukov, and Christian Hansen, "Inference on Treatment Effects after Selection among High-Dimensional Controls," *The Review of Economic Studies*, 2014, *81* (2), 608–650.

Best, Michael and Henrik Kleven, "Housing Market Responses to Transaction Taxes: Evidence from Notches and Stimulus in the UK," *The Review of Economic Studies*, 2018, *85*, 157–193.

Blinder, Alan S and Harvey S Rosen, "Notches," *American Economic Review*, 1985, *75* (4), 736–747.

Chetty, Raj, Adam Looney, and Kory Kroft, "Salience and Taxation: Theory and Evidence," *American Economic Review*, September 2009, *99* (4), 1145–77.

_ , John N. Friedman, Tore Olsen, and Luigi Pistaferri, "Adjustment Costs, Firm Responses, and Micro vs. Macro Labor Supply Elasticities: Evidence from Danish Tax Records," *The Quarterly Journal of Economics*, May 2011, *126* (2), 749–804.

Cournot, Antoine A., *Recherches sur les Principes Mathématiques de la Théorier des Richesses*, Chez L. Hachette, Paris, 1838. Translated as *Researches on the Mathematical Principles of the Theory of Wealth* by Bacon, Nathaniel T. in 1897 and published by Macmillan, London.

Fullerton, Don and Gilbert E Metcalf, "Tax incidence," *Handbook of Public Economics*, 2002, *4*, 1787–1872.

Gruber, Jonathan, *Public Finance and Public Policy*, Macmillan, 2005.

Hargaden, Enda Patrick, "Cycles and Frictions in Taxpayer Behavior," *Working Paper*, August 2018.

Kleven, Henrik Jacobsen, "Bunching," *Annual Review of Economics*, 2016, *8* (1), 435–464.

_ **and Mazhar Waseem**, "Using Notches to Uncover Optimization Frictions and Structural Elasticities: Theory and Evidence from Pakistan," *The Quarterly Journal of Economics*, May 2013, *128* (2), 669–723.

Kopczuk, Wojciech, Justin Marion, Erich Muehlegger, and Joel Slemrod, "Does Tax-Collection Invariance Hold? Evasion and the Pass-Through of State Diesel Taxes," *American Economic Journal: Economic Policy*, May 2016, *8* (2), 251–86.

Lehmann, Etienne, François Marical, and Laurence Rioux, "Labor income responds differently to income-tax and payroll-tax reforms," *Journal of Public Economics*, 2013, *99*, 66–84.

Mortenson, Jacob A. and Andrew Whitten, "How Sensitive Are Taxpayers to Marginal Tax Rates? Evidence from Income Bunching in the United States," *Job Market Paper, Georgetown University*, 2015.

Musgrave, Richard Abel, *Theory of Public Finance: A Study in Public Economy*, McGraw-Hill, 1959.

Onji, Kazuki, "The Response of Firms to Eligibility Thresholds: Evidence from the Japanese Value-Added Tax," *Journal of Public Economics*, June 2009, *93* (5-6), 766–775.

Ramnath, Shanthi, "Taxpayers' Responses to Tax-Based Incentives for Retirement Savings: Evidence from the Saver's Credit notch," *Journal of Public Economics*, May 2013, *101*, 77–93.

Saez, Emmanuel, "Do Taxpayers Bunch at Kink Points?," *American Economic Journal: Economic Policy*, August 2010, *2* (3), 180–212.

_ , Manos Matsaganis, and Panos Tsakloglou, "Earnings determination and taxes: Evidence from a cohort-based payroll tax reform in Greece," *The Quarterly Journal of Economics*, 2012, *127* (1), 493–533.

Salanié, Bernard, *The Economics of Taxation*, MIT Press, 2011.

Sallee, James M. and Joel Slemrod, "Car Notches: Strategic Automaker Responses to Fuel Economy Policy," *Journal of Public Economics*, December 2012, *96* (11), 981–999.

Slemrod, Joel, Marsha Blumenthal, and Charles Christian, "Taxpayer response to an increased probability of audit: evidence from a controlled experiment in Minnesota," *Journal of Public Economics*, 2001, *79* (3), 455–483.

Urminsky, Oleg, Christian Hansen, and Victor Chernozhukov, "Using Double-Lasso Regression for Principled Variable Selection," *Available at SSRN: https://ssrn.com/abstract=2733374*, 2016.

Weber, Matthias and Arthur Schram, "The Non-equivalence of Labour Market Taxes: A Real-effort Experiment," *The Economic Journal*, 2017, *127* (604), 2187–2215.