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Estimating the size and nature of responses to changes in income tax rates on top incomes in the UK: a panel analysis*

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Abstract

In April 2010 the UK's marginal rate of income tax above £150,000 was increased from 40% to 50%, affecting the highest-income 0.66% of the adult population (and 1% of income taxpayers). This would seem an ideal opportunity to obtain an estimate of the taxable income elasticity, but identification is impeded by forestalling (individuals bringing forward income to the year before the tax rate was increased) resulting from the reform being announced more than a year in advance.

In this paper we use panel data methods in an attempt to strip out the impact of forestalling, and estimate the underlying taxable income elasticity of those affected by the 50% tax rate, and thus the revenue-effect of the reform. In particular, we develop a new method of correcting for forestalling by averaging income over the (three year) period during which forestalling is likely to have taken place. This approach yields an estimate of the taxable income elasticity of 0.31, lower than earlier estimates by HMRC (2012) based on the same reform (but a different method), and consistent with the 50% tax raising around £1 billion a year (relative to the current 45% rate).

Three things are worth noting, however. First, is that estimated elasticities are very sensitive to changes in specification, and to the inclusion or exclusion of a small number of individuals with extremely high (and volatile) incomes. Second, at the same time the 50% rate was introduced, restrictions were placed on the amount of pension contributions some taxpayers could deduct from their taxable incomes (in advance of more general restrictions in place from 2011–12). Those forced to reduce their pension contributions (or unable to increase them) would have higher taxable income than they would have if these restrictions were not put in place: this may downwardly bias our estimate of the taxable income elasticity. Indeed, our estimates of the elasticity of broad income (before personal pension contributions are deducted) are higher – 0.71 using the same method. Finally, it is worth noting that the panel approach adopted here, by focusing on individuals who are observed both pre- and post- reform, excludes some forms of response (such as migration). Taken together, these three issues imply that higher figures for the taxable income elasticity (including those in HMRC, 2012) are plausible. Thus it is also plausible that the re-introduction of the 50% could reduce revenues somewhat: an elasticity of 0.71 would imply a reduction of around £1.75 billion if none of the lost income tax or NICs revenues were recouped from other tax bases or in other time periods.

We also explore in more detail the nature of the response to the 50% tax rate. Two findings stand out. First, when we restrict our sample to those just around the £150,000 threshold, we consistently estimate the taxable income elasticity to be between 0.1 and 0.2, implying that behavioural response to the higher tax rate is concentrated among those with the very highest incomes. Second, we find little evidence that individuals responded to the higher tax rate by increasing use of tax deductions. However, this must be a tentative conclusion as not all deductable items are recorded on the tax return data available. Particularly relevant in this context is the possibility that owners of closely-held incorporated businesses chose to respond to the 50% tax rate by retaining income in their business, for extraction at a later date (perhaps in the form of capital gains rather than dividends). Analysis of such responses would require the linking of personal and corporate income tax returns, which is a subject for future research.

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I. Introduction

In April 2010, the marginal rate of income tax above £150,000 was increased from 40% to 50% in the UK, affecting the highest-income 0.66% of the adult population. When the policy was announced in 2009, the government at the time estimated that this would raise about £2.5 billion a year, under an assumption that the taxable income elasticity of this group was 0.35 (the pre-behavioural yield was estimated to be about £7 billion).

As the top income tax rate had previously remained unchanged for more than twenty years prior to this, the introduction of the 50% tax rate would seem an ideal opportunity to obtain an estimate of the taxable income elasticity - and therefore verify the initial costing. However, because the increase in the tax rate was announced more than a year before it took effect, those affected by the reform had an incentive, and in many cases, the opportunity to bring forward income from 2010–11 and beyond in to 2009–10 – a phenomenon termed 'forestalling'. This means that the most obvious approach to estimating the long-run impact of the tax change on taxable incomes, and hence government revenues – by examining the change in the incomes of those affected between 2009–10 and 2010–11 – will not give an unbiased estimate of the long run taxable income elasticity, as this will conflate the long run impact of the reform and temporary forestalling.

In this paper, we use various methodologies to separate out the effect of forestalling in order to estimate the long run impact of the reform on individuals' incomes and tax revenues. We also explore the nature of the response to the 50% tax rate, in particular whether responses took the form of reductions in total income, or increases in the use of tax deductions, since this has a significant impact on the welfare cost and long-term revenue effects of tax rate changes (Saez, Slemrod and Giertz, 2012). Therefore, our paper has two main contributions.

First, it adds significantly to the limited evidence that currently exists about responses to a major UK tax policy reform and more broadly to the responsiveness of high-income earners to tax rate changes in the UK. Knowing how high income individuals will respond to higher tax rates is important as it is a key determinant of optimal income tax rates for high income individuals, an important issue given growing inequality in many developed countries. Examining the UK is an interesting case since it has a broader tax base than the US and many other developed countries (in particular, no mortgage interest payments are tax-deductable), meaning that there is less scope for taxpayers to increase their use of tax shelters or deductions in response to higher tax rates.

An initial evaluation of the 50% tax rate was undertaken by Her Majesty's Revenue and Customs (HMRC), the UK's tax authority, utilising an aggregate difference-in-difference estimator, ad-hoc adjustments to account for forestalling, and income information from promptly filed income tax returns for 2010–11 (HMRC, 2012). The resulting estimate of the taxable income elasticity is 0.48, substantially higher than the 0.35 assumed when the policy was announced and costed, but in-line with estimates based in large part on the last major change to the UK's top rate of tax in the 1980s (Brewer, Saez and Shephard, 2010). A companion paper (Browne and Phillips, 2017) discusses the methodology of HMRC (2012) in more detail, updates it by using more recent data and shows the sensitivity of the results to changes in the specification of the model. It points to a number of factors which suggest, if anything, that HMRC's precise methodology is likely to have led to an underestimate of the taxable income elasticity, although other factors – including reverse forestalling in anticipation of the subsequent cut in the top rate of tax, and the retention of income in businesses – may mean estimates overstate long-run responsiveness. This paper builds on this aggregate-level analysis by using a different approach that is more common to the existing literature in this area, namely using panel data to examine the responses of particular individuals after the introduction of the higher tax rate.

The main difference between the approach taken by HMRC (and extended and critiqued in Browne and Phillips, 2017) and that taken in this paper is the degree of

aggregation. HMRC's estimates are largely based on aggregate incomes for those with incomes above £150,000 (the range affected by the 50%) rate and just below this level (£115,000 to £145,000): individual-level panel data is used only as part of efforts to strip out the effects of forestalling. In this paper, we use panel data methods for estimating taxable income elasticities that are more typical of the taxable income elasticity literature (following Feldstein, 1995). HMRC's aggregate income method has the benefit that it can incorporate responses such as migration that mean given individuals are not observed both before and after the reform. On the other hand, given our reliance on a sub-set of taxpayers (those completing self-assessment tax returns), we can incorporate the response of individuals that can be observed in both time periods only, meaning we do not pick up responses like migration.[1] The benefit of our panel approaches over HMRC's is their greater robustness to re-ranking of individuals in the taxable income distribution as their incomes change over time and greater comparability with other studies.

Second, we utilise a number of approaches in an attempt to account for forestalling when tax changes are announced in advance. This is an under-researched area of the taxable income elasticity literature, but one that is clearly important for many practical applications (Goolsbee, 2000; Saez, Slemrod and Giertz, 2012; Parcell, 1995; and Sammartino and Weiner, 1997).

We begin with models similar to those of Gruber and Saez (2002), examining the changes in income among individuals affected by the tax rise and comparing these with the income changes of those with slightly lower incomes. We examine both one-year changes in income between 2009–10 and 2010–11 (which are of course affected by forestalling) and also income changes measured over a longer time period, in particular comparing incomes 2011–12 with those in 2008–09 (the latter of which should not be affected by forestalling). Next, we examine the impact of the tax rise on individuals' total incomes over the three year period from 2009–10 to 2011–12 as a whole. Under the assumption that all of the income brought forward to 2009–10 would otherwise have arisen in 2010–11 or 2011–12, this strips out forestalling effects and provides an estimate of the long-run taxable income elasticity. Finally, we examine the responses of those who had incomes around the £150,000 threshold in 2009–10: given that these individuals did not bring income forward from later years (since this would likely have taken their income further above £150,000), their response in 2010–11 should more likely represent the underlying response to the change in tax rates, albeit for a selected group of taxpayers.

A number of key findings emerge from this analysis. First, is that estimates are very sensitive to the precise specification used. This reflects the fact that the combination of significant forestalling in response to the 50% tax rates and the short period for which the 50% rate was in place (and even shorter period before a reduction in the rate was pre-announced), make estimation of the underlying taxable income elasticity with precision, difficult: different methods and assumptions for stripping out 'temporary' effects lead to significantly different estimates of the elasticity. Second, and related to this, is that for this reform, the typical panel approach, a la Gruber and Saez (2002), does not do a very good job of stripping out the effects of forestalling. Our preferred approach is instead where we examine the impact of the 50% tax rate on incomes between 2009–10 and 2011–12 inclusive. Under the assumption that forestalling involved bringing forward income from 2010–11 and 2011–12 only, this yield a central estimate of the taxable income elasticity of 0.31, lower than the 0.48 estimated in HMRC (2012). This would be consistent with the 50% tax rate raising £2.5 – 3 billion a year relative to a 40% rate, and £1 billion a year relative to a 45% rate, if revenues lost as a result of underlying behavioural response were not recouped (in part) via other tax bases or in other time periods

[1] If an individual were not observed in the pre-reform or post-reform time period in our data, we would know whether their taxable income were actually zero (e.g. if they lived outside the UK or had zero income) or that their income and circumstances in that period simply meant they did not need to file a tax return.

However, it would be unwise to conclude that HMRC's estimates are 'too high' for at least three reasons. First, the statistical uncertainty around the estimates, and the aforementioned sensitivity to the specification and assumptions used. Second, it is worth noting that at the same time as the 50% rate was introduced, restrictions were placed on the amount of pension contributions some taxpayers could deduct from their taxable incomes (in advance of more general restrictions in place from 2011–12). Those forced to reduce their pension contributions (or unable to increase them) would have higher taxable income than they would have if these restrictions were not put in place: this may downwardly bias our estimate of the taxable income elasticity. Indeed, our estimates of the elasticity of broad income (before any pension contributions are deducted) are higher – 0.71 using the same method. Third is the fact that HMRC's estimates may be picking up some forms of behavioural response – such as migration – that our panel approach cannot pick up. Taken together, these three factors imply that a figure for the elasticity than is higher than our central estimate (and indeed higher than HMRC's), would be plausible. A higher elasticity would imply that a 50% top rate would raise less or even lead to a reduction in revenues (an elasticity of 0.71 would imply it would cost around £2 billion, for instance, if revenues were not recouped via other tax bases).

It is also possible, though, that estimates of the taxable income elasticity are overstating the degree to which behavioural response will impact tax revenues. For instance, if individuals are making greater up-front deductions from taxable income, this will reduce taxable income now but may lead to more tax being paid later on or via another tax. We actually find little evidence that reductions in taxable income took the form of increased use of deductible items that can be observed on the tax return (such as individual's contributions to private pensions). But this does not rule out the possibility that part of the behavioural response was the result of increased use deductable items that cannot be observed on the tax return (such as individual and employer contributions to occupational pensions). Moreover, certain types of taxpayers have additional opportunities to shift income over time or to other tax bases. For example, dividend income appears particularly responsive to the higher tax rate, which may reflect the fact that owners of businesses can choose to retain income in their company, taking dividends years down the line, or taking income in the form of capital gains through selling shares in the company (and so instead paying capital gains tax). These sorts of responses – whereby some of the income tax foregone in the short-term can be recouped later on or via other taxes – cannot be picked up in analysis of short-term income tax data only.

The upshot of all this is that it is clear that there was a substantial behavioural response to the higher tax rate, and that it is very likely that some of this was a change in underlying behaviour rather than simply shifting incomes between time periods. Our estimates – and those obtained by HMRC (2012) – are reasonable and plausible estimates to guide policymakers, even if we cannot produce a definitive estimate of the relevant taxable income elasticity. A 50% tax rate may therefore raise a couple of billion or cost a couple of billion, relative to today's 45% rate. More precise estimates of the taxable income elasticity – and of these revenue effects – would be possible only following a change to the top rate of tax that did not generate such large forestalling effects (for instance, if the change were not pre-announced). The linking of individual and corporate tax records would also be useful to examine retained income in businesses.

The rest of this paper proceeds as follows. In Section II, we describe the policy background in more detail. Section III describes the data used in our analysis. Section IV shows the results of our panel regression analysis, making use of several different methods to overcome the problem of forestalling. In Section V, we examine the nature of the response to the 50% rate, examining the extent to which changes in taxable income reflect increased use of tax deductable items rather than a genuine reduction in income. Finally, Section VI discusses the implications of the analysis for both tax policy, and the empirical estimation of taxable income elasticities.

II. Policy background

Prior to the 2010 reforms, the last time the rate of tax faced by those with the very highest incomes was changed was 1988 when the 60%, 55%, 50% and 45% rates of income tax were abolished. The highest 60% rate had applied to incomes above approximately £110,000 in today's prices. Earlier reforms in 1979 substantially raised the thresholds for these rates, and had abolished additional higher rates of 65%, 70%, 75% and 83%. Using the variation in tax rates generated by both these reforms and earlier reforms in the 1960s and 1970s, which were generally announced with immediate effect, Brewer, Saez and Shepherd (2010) estimated a taxable income elasticity[2] for the top 1% of UK taxpayers – equivalent to an income above approximately £160,000 in today's terms – of 0.46. This would imply a revenue maximising effective marginal tax rate (incorporating not only income tax, but also, in general, National Insurance and potentially consumption taxes) of 56%.[3] (With the additional rate of income tax set at 50%, the effective marginal tax rate on incomes above £150,000 was 57.8% excluding and approximately 64.1% including consumption taxes).[4]

The taxable income elasticity is not a constant or immutable parameter: it will depend both on how responsive individuals are to changes in the tax rate they face, which could change over time depending on the outside options they face, and on the structure of the tax system, in particular whether individuals can avoid paying high rates of income tax by shifting income into tax shelters or other less heavily-taxed bases. Since the 1980s, efforts to broaden the UK's tax base, for example by eliminating tax relief on mortgage interest and life assurance premiums, would tend to have reduced the taxable income elasticity. On the other hand, the increasing globalisation of the world economy might have increased the opportunity for those with high incomes in the UK to work in other countries. But the stability in the top income tax rate between the late 1980s and 2010 has meant a lack of opportunity to calculate more up-to-date estimates of the taxable income elasticity of high income individuals.

At first glance, the increase in the rate of tax from 40% to 50% on incomes above £150,000 would seem an ideal opportunity to assess the responsiveness of high income individuals to the rate of income tax. However, there are several features of the reforms in the early 2010s that impede estimation of the long-run taxable income elasticity. First, the increase in the top tax rate to 50% was announced more than a year in advance, enabling those potentially affected to bring forward income from 2010–11 and future years to 2009–10 to avoid paying the higher tax rate. It is clear from the data that many such individuals took advantage of this opportunity. Secondly, when the new tax rate was announced, the government stated that it was a 'temporary' measure, potentially inducing people to delay receiving income in 2010–11 and 2011–12 until after the tax rate had been lowered again. Indeed, a reduction in the rate to 45% was announced shortly before the end of the 2011–12 tax year, to be applied from 2013–14 onwards. Thus, there is no

[2] The taxable income elasticity measures the percentage change in the amount of taxable income taxpayers report when there is a 1 percent change in proportion of a marginal £1 of income that is retained after tax. For instance, if marginal income is taxed at a rate of 20%, the net-of-tax rate is 80%: the taxable income elasticity would measure the percentage change in the amount of income reported for a 0.8 percentage point (1% of 80%) change in the net-of-tax rate. Feldstein (1999) shows how, under certain circumstances, the taxable income elasticity provides a summary measure of the efficiency costs of taxation. It is also an important determinant of the revenue effects of tax changes: the greater the extent to which people reduce their reported income when tax rates increase, the less a tax increase will raise in revenues.

[3] The revenue-maximising rate is calculated assuming a Pareto parameter of 1.70 (which is similar to that based on SPI data from 2007–08, the last year for which data is available and unaffected by temporary responses to the 50% tax rate, and published summary statistics for SPI data from 2013–14). See Saez, Slemrod and Giertz (2012) for formula for calculating revenue maximising tax rate. Note also that this rate assumes that all tax revenues are affected by reductions in income as declared for income tax purposes, which may not be the case in reality. If behavioural responses to higher income tax rates take the form of shifting income to other time periods or tax bases or tax-favoured forms of income, consumption tax revenues may not be affected, which would alter this calculation and imply a higher revenue-maximising tax rate overall.

[4] Assuming an effective marginal tax rate on consumption of 15% (incorporating both VAT and excise duties).

year in which the level of taxable income reported by the affected group reached its expected long-run level.

Other tax changes introduced around the same period are a third factor that may affect changes in taxable incomes of those affected by the 50% rate in 2010–11. For example, a restriction on the amount individuals can contribute to private pensions was implemented in 2011–12 (the annual amount individuals could contribute to a pension was reduced from £255,000 to £50,000), with measures introduced in 2010–11 with the aim of preventing people significantly increasing their pension contributions in that year to limit the impact of the change. This measure would, other things being equal, increase the taxable incomes of those who would otherwise have wanted to make a pension contribution of more than £50,000. The introduction of a small band of income between £100,000 and approximately £113,000 where the effective income tax rate was 60% (described as the withdrawal of the personal allowance, the amount of taxable income on which no income tax is charged) may have affected the incomes of those with slightly lower incomes who are the natural comparison group. There was also a one-off tax on bank payrolls in 2009–10 that would have the effect of weakening the incentive for those working in the banking sector to have bonuses paid in 2009–10 rather than 2010–11, potentially limiting the extent of forestalling.

An official evaluation of the 50% tax rate undertaken by HMRC in early 2012 attempted to strip out the effect of each of these measures, in order to estimate the underlying degree of responsiveness of taxable income to tax rates. This analysis, based largely on aggregated income tax, obtained a central estimate of the taxable income elasticity of 0.48, but with very wide margins of uncertainty around it. Such a taxable income elasticity would imply that the 50% income tax rate was above the revenue maximising tax rate. In this paper, we use different methodologies, making much more use of panel data rather than aggregate income figures. As in HMRC's (2012) original analysis, we find estimates to sensitive to specification and uncertain due to difficulties in accounting for re-timing and re-classification of income. However, analysis of the responsiveness of individual taxpayers (as opposed to aggregate incomes) does provide further evidence that there was significant underlying as well as temporary re-timing (forestalling) effects.

III. Taxpayer data

Our data is the universe of tax records of those required to fill in a Self Assessment (SA) tax return. Only around a third of those liable to pay income tax in the UK have to complete a tax return – the remaining two thirds are completely dealt with through the PAYE withholding system that involves exact cumulative deduction at source, which means that the correct amount of tax is paid by the end of the year in most cases.[5] The rules governing who has to submit an SA return have changed over time, but since 2010–11 almost all of those with incomes above £100,000 have been required to submit a self-assessment form.

The self assessment data includes total and taxable income, by source, and information on deductions and tax allowances claimed. However, it does not include full information on all deductable items, most notably contributions to pension schemes run by employers (though we do see all pension contributions for some groups, such as the self employed). It also does not contain information on taxpayers' demographic characteristics or the incomes and characteristics of their spouse or partner (if they have one).

A key feature of the SA data is that the annual tax records can be linked over time to create a panel dataset covering the period from 1999–00 onwards.[6] This allows one to

[5] 10.34 million people were asked to submit a SA tax return in 2011–12, the latest year we examine in this paper, out of a total of 30.8 million income taxpayers in that year. See https://www.gov.uk/government/news/record-on-time-tax-returns and https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/429111/Table_2.1.pdf.

[6] In principle it is possible to link data back further, but differences in data structure make this difficult.

track the incomes of specific individual over time, allowing the estimation of taxable income elasticities using panel models. This is different to the other main source of administrative data on individuals' taxable incomes in the UK, the Survey of Personal Incomes (SPI), which is a repeated cross section. It is only in the last few years that access to the SA data has been given by HMRC to external researchers, and this is the first paper to make use of these data to estimate taxable income elasticities.

IV. Panel regression analysis

In this section, we exploit the panel structure of the SA data to estimate the taxable income elasticity using individual level panel data. Use of the individual panel element brings both benefits and difficulties. The key difficulty is that transitory shocks to incomes mean that the incomes of individuals are subject to mean-reversion:[7] individuals with temporarily high incomes are likely to see falls in their income subsequently, and vice versa. This mean-reversion needs to be accounted for when estimating taxable income elasticities (Saez, Slemrod and Giertz, 2012).

The most common instrumental variable approach for estimating taxable income elasticities using panel data (Gruber and Saez (2002)) does not overcome this problem directly. This approach instruments for the change in an individual's (net of) tax rate between period t-j and t with what the change in their tax rate would have been had their income remained at their t-j level. However, if the change in tax rate is correlated with income in period t-j this will still not be exogenous because of the problem of mean-reversion (or secular trends in income inequality).

Gruber and Saez attempt to control for this by including a 10-piece spline of taxable income in period t-j (others use other linear or non-linear functions of income in period t-j). Kopzcuk (2005) critiques this, arguing that mean reversion and secular trends are separate phenomenon and should be controlled for separately. He suggests this can be done by instrumenting for the change in the net of tax rate using what the change would have been if income remained at its t-j-1 level, and including functions of income in t-j-1 (for secular trends), and the change in income between t-j-1 and t-j (for mean reversion).[8] Where possible, we use both types of approaches in our empirical analysis to examine the sensitivity of results to these different specifications.

IV.1. One, two and three year panels of all individuals with incomes greater than £70,000 or £115,000

First, we estimate the taxable income elasticity using panels of all individuals with incomes above either £70,000 or £115,000 in the base year.[9] We do this using changes in taxable incomes and net-of-tax rates faced by each individual between year t-j and t, for j=1,2 and 3 (i.e. panels based on 1 year, 2 year, and 3 year intervals).

Formally, we estimate the elasticity, e, using:

[7] As discussed in the introduction, a further difficulty given that our tax data covers only a subset of taxpayers (those filing self-assessment tax returns) is that if an individual leaves the data, we do not know whether their taxable income is zero (for instance if they have migrated or stopped working) or positive but their tax affairs are such that they no longer need to fill in a self-assessment form. We therefore restrict our attention to those included in the data both pre- and post-reform, such that our estimated elasticities do not capture responses that would lead someone to exit the data (such as migration).

[8] Weber (2014) suggests instead using instruments based on t-3j (as well as t-2j), and also shows how to test for the appropriateness of particular instrumentation and control strategies. We use these tests in some of the analyses below.

[9] We use both to test the sensitivity of results to sample choice, and in particular, to inclusion of those affected by the 60% tax rate between £100,000 and £100,000 plus twice the amount of the personal allowance from 2010–11 onwards (approximately £113,000 in that year and £115,000 the following year) as a result of the tapering away of the personal allowance above £100,000.

where y is taxable income, τ is the tax rate, d is a time period dummy, FTSE is the average quarterly closing price of the FTSE All Share index, and changes Δ are calculated as: $\Delta \log(y_{it}) = \log(y_{it}) - \log(y_{it-j})$ and). When using the Gruber and Saez (2002) instruments, k=0 and is omitted from function *f*. When using the Kopczuk (2005) instrumentation approach, k=1.

When j=1, identification of the effects of 50% tax rate and the taxable income elasticity comes from comparing incomes in 2009–10 and 2010–11. These estimates will be affected by forestalling in both the pre- and post- reform periods (with income temporarily high in 2009–10 and temporarily low in 2010–11). When j=2, identification of the effects of the 50% tax rate and the taxable income elasticity comes from comparing incomes in 2008–09 with 2010–11, and 2009–10 with 2011–12. Note that incomes in 2008–09 should be unaffected by forestalling, and one may expect incomes in 2011–12 to be somewhat less affected by forestalling than incomes in 2010–11 (if it is easier to bring income forward one year rather than two). This means estimates based on two year panels should be less affected by forestalling than estimates based on one year panels. All else equal, we would expect this to lead to lower estimates of the taxable income elasticity from the two year panel than the one year panel. When j=3, identification comes from comparing incomes in 2007–08 with 2010–11, and 2008–09 with 2011–12. This should mean that estimates based on 3-year panels should be least affected by forestalling, especially if one uses a non-overlapping panel where only the change between 2008–09 and 2011–12 is used for identification of the effect of the reform. Indeed, this approach of extending the interval between panel periods (i.e. increasing j) is one of the most common approach in the taxable income literature to avoid biased estimates of the underlying elasticity due to temporary income shifting (Saez, Slemrod and Giertz (2012)).

Tables 4 and 5 show estimates of the elasticities for 1, 2 and 3 year panels – including a version of the 3 year panel where only the 2008–09 to 2011–12 difference is used for identification of the effects of the reform.[10] The estimates reported in Table 4 uses the method of Kopczuk (2005), while Table 5 is based on Gruber and Saez (2002). Estimates are weighted by an individual's base year income, since this gives us the relevant elasticity for calculating the revenue effects of tax changes (estimates based on unweighted data are available in the Appendix): the response of higher income individuals will have a larger impact on tax revenues. The top half of the tables show results for samples consisting of those with incomes above £115,000 in the base year, and the bottom half show results for samples consisting of those with incomes above £70,000 in the base year.

The most striking feature of the estimates is their sensitivity to the precise way in which mean reversion and secular trends are controlled for. For instance, elasticity estimates using 3-year non-overlapping panels (reported in Column 4 of the Tables) range from 0.467 to 2.406 when using the Kopczuk instruments.[11] And for the 1-year panels (reported in Column 1), estimates vary from 1.367 to 7.405 when using the Gruber and Saez instruments. This sensitivity to specification has been widely reported in the literature (see, for instance, the review by Saez, Slemrod and Giertz (2012)), but is particularly extreme in this example, perhaps because of the impact of forestalling (in addition to the usual problem of mean reversion).

The specifications based on splines interacted with stock market growth (to allow for stock market growth to impact income growth differentially across the distribution of income) provide the most flexible set of controls. In general, controlling for this differential impact leads to higher estimated elasticities. This likely reflects increases in

[10] More precisely, in column (4) we report results where we have non-overlapping 3 year panels covering the years 2002–03 to 2005–06, 2005–06 to 2008–09 and 2008–09 to 2011–12.

[11] The lower estimate is obtained with a sample consisting of all individuals with incomes over £70,000 in the base period when a cubic function of the log of taxable income in the period before the base period, and the change in the log of taxable income between that period and the base period, are used. The higher estimate is obtained with a sample of all individuals with incomes over £115,000 in the base period

stock prices in the years following the reform (which coincided with recovery from the late 2000s financial crisis), which would be expected to disproportionately boost the incomes of those with the highest incomes (so that the falls observed for such people represent an even greater departure from the implicit "no reform" counterfactual projections).

The second thing worth noting is that elasticity estimates obtained from 2 or 3 year panels are *not* consistently smaller than those obtained from the 1 year panels. This is somewhat surprising given the expectation that longer period panels would be less subject to the issue of forestalling. For the Kopczuk method, estimates *are* smaller when controls for mean reversion and secular trends are based on polynomials of income, but are of broadly the same value when spline-based controls are used. For the Gruber and Saez method, estimates are generally smaller for the 2- and 3-year panels than the 1 year panels, but remain very large in absolute magnitude. The use of 2- or 3-year panels does not seem to overcome the problems caused by forestalling, at least in the case of this particular reform. In principle, longer panels (e.g. 5) may be expected to perform better (if income can be brought forward by 1 or 2 years, but not 3 or 4 years, say), although this may reduce sample size, and may not be possible for reforms that are followed (or preceded) by other reforms (especially if those other reforms were also pre-announced). For instance, it would not be possible to use a 5-year panel (e.g. between 2007–08 and 2012–13) in this case, because the UK government pre-announced a reduction in the 50% rate to 45% in March 2012 to take effect in April 2013–14. This would lead to individuals delaying their income from 2012–13 to 2013–14 in order to take advantage of the lower tax rates. This temporary 'reverse forestalling' would also tend to increase estimated elasticities above the level of the underlying long-run elasticity.

Third, estimated elasticities are generally smaller when the sample consists of all those with incomes above £70,000 rather than those with incomes above £115,000 in the base year. This may reflect the fact that the former sample is more likely to include those individuals with incomes between £100,000 and £115,000 who are affected by the 60% marginal rate created by the tapering away of the personal allowance from 2010–11 onwards. If people were relatively less responsive to this 60% tax rate than the 50% rate (because of the complexity of it reducing its lesser salience, or people with lower incomes being generally less responsive, perhaps), this would reduce estimates of the overall responsiveness of the group.

Fourth, comparison of Table 4 with Table A1 in Appendix A, which presents estimated elasticities based on unweighted data, shows that weighted estimates are consistently larger. This may reflect two factors. First, and most obviously, individuals with higher incomes (who have more impact on estimates in the weighted data) may be more responsive to changes in tax rates – in terms of underlying long term responses and/or temporary forestalling responses. Second is a mechanical effect caused by forestalling behaviour. In the 1 and 2 year panels, those with high incomes in the year prior to the tax change – who are given a high weight in the weighted data – will include those who have brought forward substantial amounts of income, and will therefore subsequently have low incomes in the year(s) immediately after the reform. This large fall in income following the reform will also mean such individuals also appear to be highly responsive to the reform. If forestalling effects were the main factor driving these differences, one would expect the difference in estimates between the weighted and unweighted data to be greatest for the 1-year panels, and the least for the 3-year panels. This is not generally the case, which may suggest that differences in underlying responsiveness between people with different income levels may play a significant role in the differences in weighted and unweighted estimates (and perhaps differences between estimates based on the £70,000+ and £115,000+ samples).

TABLE 4

Panel estimates of the taxable income elasticity, weighted, Kopczuk method

	Number of years between t-1 and t			
	1	**2**	**3**	**3***
All individuals > £115k				
No controls	0.912	0.759	0.906	0.687
	(0.166)	(0.065)	(0.123)	(0.191)
Linear controls	1.648	1.383	1.202	1.360
	(0.141)	(0.084)	(0.139)	(0.226)
Quadratic controls	1.096	0.805	0.709	0.684
	(0.136)	(0.083)	(0.136)	(0.226)
Cubic controls	1.263	0.947	0.877	0.832
	(0.144)	(0.085)	(0.144)	(0.220)
Spline	2.202	2.147	2.349	2.356
	(0.145)	(0.093)	(0.155)	(0.254)
Spline interacted with stock growth	2.566	2.658	2.284	2.406
	(0.150)	(0.101)	(0.156)	(0.255)
All individuals > £70k				
No controls	1.991	1.680	1.777	1.565
	(0.082)	(0.028)	(0.058)	(0.084)
Linear controls	1.470	0.871	0.728	0.730
	(0.069)	(0.033)	(0.062)	(0.093)
Quadratic controls	1.181	0.632	0.547	0.467
	(0.069)	(0.033)	(0.062)	(0.097)
Cubic controls	1.295	0.724	0.659	0.583
	(0.071)	(0.034)	(0.063)	(0.094)
Spline	1.852	1.378	1.479	1.469
	(0.070)	(0.035)	(0.065)	(0.100)
Spline interacted with stock growth	2.166	1.793	1.417	1.514
	(0.072)	(0.038)	(0.065)	(0.099)
Memo: HMRC estimate	0.48	n/a	n/a	n/a

Note: Standard errors are in parentheses. 3* regressions include no overlapping 3 year panels.
Source: Authors' calculations using SA302 data from 1999–00 to 2011–12.

Overall though, the standard approach for addressing the effects of temporary re-timing of income – utilising longer panel intervals – does not appear to lead to stable estimates of the taxable income elasticity, nor address forestalling satisfactorily.

TABLE 5

Panel estimates of the taxable income elasticity, weighted, Gruber and Saez method

	Number of years between t-1 and t			
	1	**2**	**3**	**3***
All individuals > £115k				
No controls	7.405	7.061	7.170	7.212
	(0.115)	(0.099)	(0.113)	(0.170)
Linear controls	2.816	0.987	0.382	0.907
	(0.089)	(0.084)	(0.095)	(0.156)
Quadratic controls	3.690	2.423	1.934	2.225
	(0.094)	(0.094)	(0.112)	(0.202)
Cubic controls	3.719	2.587	2.089	2.593
	(0.091)	(0.095)	(0.110)	(0.193)
Spline	3.424	2.446	1.884	2.416
	(0.082)	(0.087)	(0.098)	(0.163)
Spline interacted with stock growth	3.766	3.563	2.401	2.678
	(0.083)	(0.095)	(0.100)	(0.171)
All individuals > £70k				
No controls	3.442	3.629	8.689	9.309
	(0.046)	(0.043)	(0.359)	(0.705)
Linear controls	1.367	0.377	2.995	4.742
	(0.039)	(0.040)	(0.271)	(0.664)
Quadratic controls	1.760	1.051	3.010	4.299
	(0.040)	(0.041)	(0.271)	(0.612)
Cubic controls	1.784	1.094	2.798	3.530
	(0.040)	(0.041)	(0.272)	(0.564)
Spline	1.558	1.089	2.612	3.029
	(0.035)	(0.041)	(0.247)	(0.503)
Spline interacted with stock growth	1.735	1.770	2.604	3.816
	(0.035)	(0.044)	(0.246)	(0.657)
Memo: HMRC estimate	0.48	n/a	n/a	n/a

Note: Standard errors are in parentheses. 3* regressions include no overlapping 3 year panels.
Source: Authors' calculations using SA302 data from 1999–00 to 2011–12.

IV.2. Panel based on 3-year averages of income

Our next approach is to examine the changes in incomes averaged over a three year period. The motivation for this comes from noting that if the forestalling fully unwound by the end of 2011–12 (and that the subsequent tax cut was unanticipated so that individuals were not delaying income from 2011–12 to subsequent years), the average income over these three years is unaffected by forestalling and so should give an unbiased estimate of the structural taxable income elasticity. As in our previous analysis, we instrument the change in the net of tax rate using a prediction of what the change in the net of tax rate would have been given the individuals' income in the previous three years,[12] though unlike in the previous subsection, we are unable to use the instruments

[12] We take variation in an individual's income over the previous three year period into account when making this prediction, though the ordering of their income does not matter. For example, an individual whose income would only have been high enough in one of the previous years to have been paying the 50% rate is assumed to have an income that high one third of the time when making the prediction, irrespective of which of the three years they had this higher level of income in.

suggested by Kopczuk (2005) and Weber (2014) due to data constraints, so present results using the method suggested by Gruber and Saez (2002) only.[13]

Formally, we estimate:

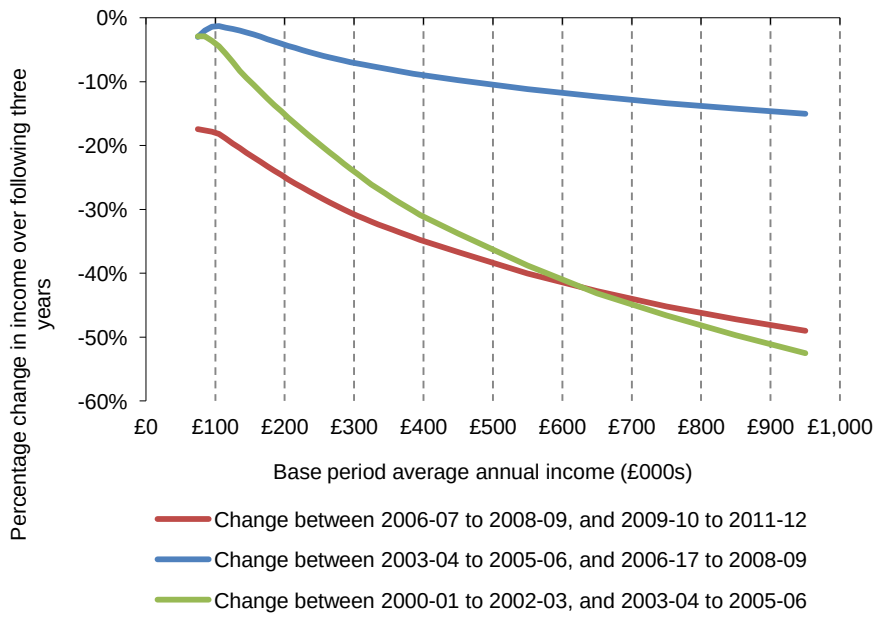
(2)

where y is taxable income, τ is the tax rate, d is a time period dummy, FTSE is the average quarterly closing price of the FTSE All Share index and bars indicate each variable is averaged over three years (i.e. years t, t-1, and t-2: thus, for instance, $_{-3}$)). Our identification comes from comparing income growth between the three year period covering 2006–07 and 2008–08, and the three year period 2009–10 to 2011–12 with growth during previous 3 year periods, for individuals above and just below the £150,000 threshold at which the 50% tax rate applied. We vary the specification of the base year income controls used to control for mean reversion, adding a linear control in base-year income and a 20-piece spline.

As in the analysis in the previous sub-section, we also interact the spline with stock market growth between the two relevant periods. Figure 4 motivates the inclusion of this interaction term in our analysis by showing that the extent of mean reversion is far from stable over time. We can see much greater reductions in income for the very richest in the first of our pre-reform periods (comparing the three-year period 2000–01 to 2002–03 with that from 2003–04 to 2005–06) and the reform period (comparing the three-year period from 2006–07 to 2008–09 with that from 2009–10 to 2011–12), both periods when stock markets were falling (following the bursting of the dot-com bubble in the first instance and during the global financial crisis in the second) than in the immediate pre-reform period when stock markets were growing strongly. This demonstrates the need to control for stock market growth in our analysis to avoid conflating the impact of stock market growth with the behavioural response to the higher tax rate.

FIGURE 4

Change in three-year average income by base period average income



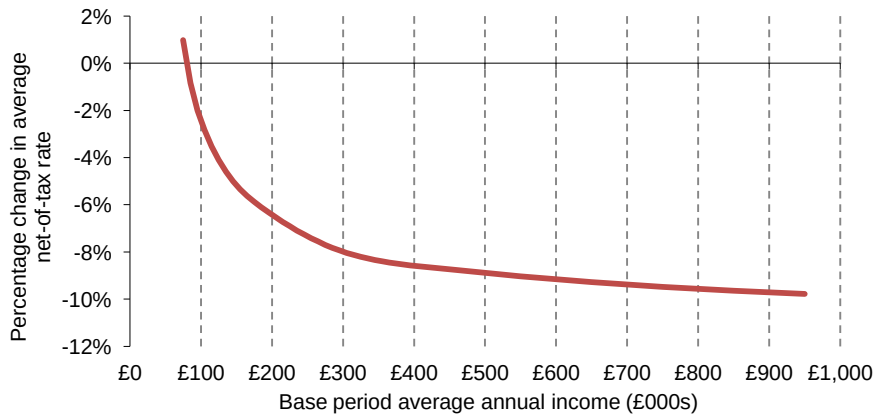
Note: Lowess-smoothed lines.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

[13] As the length of our panel is only twelve years, we can only compare three sets of differences between three year periods, which would be further reduced if we used data on incomes from previous years to construct our instrument.

We select our sample based on average income in the base (three year) period (as in Figure 4 above). We again vary the lower cutoff for selecting our sample, since there is a trade off between selecting a sample that is as similar as possible to the group affected by the 50% tax rate and increasing the amount of variation in tax rates incorporated in our analysis (as discussed previously, the reform described as withdrawing the personal allowance from individuals with incomes greater than £100,000 increased the effective marginal income tax rate to 60% between £100,000 and around £115,000). Figure 5 shows how the change in the log net-of-tax rate varies by base period income. We see that for those with average incomes below £80,000 in the base period, the average change in the net-of-tax rate is positive (i.e. a reduction in the tax rate): this arises because more of these individuals fall into a lower tax bracket in the subsequent three-year period than are affected by the new higher tax rates in the following period. For those with higher incomes in the base period, an increasing proportion are affected by the new higher marginal tax rates (both 60% and 50%) in the following three-year period, showing the strength of our instrument that uses base-year income to predict changes in the net-of-tax rate.

FIGURE 5

Change in three-year average net-of-tax rate between three-year periods starting in 2006–07 and that starting in 2009–10, respectively, by average annual income between 2006–07 and 2008–09



Note: Lowess-smoothed lines.
Source: Authors' calculations using SA302 data from 2006–07 to 2011–12.

In all cases, we weight our results by pre-reform income, since this gives us the relevant elasticity for calculating the revenue effects of the tax rise. Equivalent results from unweighted regressions can be found in the Appendix (Table A2).

Table 6 shows our estimation results. As before, in panel A we use lower cutoff of £70,000 and in panel B a higher cut-off of £115,000 (both in 2010–11 prices).[14] The results show a degree of sensitivity to the specification used, though the choice of cutoff does not seem to be especially important. The very high estimates that we obtain when we do not control for mean reversion show the necessity of controlling for mean reversion, but it appears that adding additional terms above a quadratic does not make a significant difference – we obtain similar results when we add a cubic term or a 20 piece linear spline with taxable income elasticity estimates between 0.83 and 0.92 (which are not statistically significantly different from each other). Controlling for the impact of stock market growth at different income levels significantly reduces our taxable income elasticity estimates, as part of the lower income growth at higher income levels following the reform is explained by stock market falls rather than the tax change.[15] In this case, our

[14] Recall that £115,000 is roughly the income level where the 60% marginal tax rate generated by the withdrawal of the personal allowance above £100,000, dropped back down to 40% in 2010–11 and 2011–12.

[15] Note that in our analysis based on single-year comparisons, controlling for stock market growth led to *increases* in the estimated elasticity because stock market values *increased* between both 2008-09 and 2009–10 (just before the reform) and

estimates of the taxable income elasticity – 0.42 when using linear controls, and 0.31 when using spline controls – are smaller than those obtained by HMRC (2012), whose central estimate was 0.48, though this remains within the 95% confidence interval in both cases.

An elasticity of 0.31, for instance, would imply that relative to a 45% top rate of tax (as is currently the case) a 50% would raise around £1 billion more, if revenues lost as a result of underlying behavioural response were not picked up in other tax bases (such as capital gains tax) or in other time periods. But the 95% confidence intervals for the elasticity (approximately 0.09 to 0.53) imply 95% confidence intervals for the revenue effects of a 50% rate that span from less than zero, to more than £2.5 billion, on the same basis.

TABLE 6

Taxable income elasticities calculated using change in three-year average income

	(1)	(2)	(3)	(4)	(5)	(6)
A: £70,000 threshold						
Taxable income elasticity	2.59***	0.42***	0.87***	0.92***	0.91***	0.31***
Standard error	(0.085)	(0.093)	(0.099)	(0.098)	(0.098)	(0.111)
Linear base-year income control	No	Yes	Yes	Yes	No	No
Quadratic base-year income control	No	No	Yes	Yes	No	No
Cubic base-year income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	25,651	20,836	16,630	17,170	17,159	12,876
Number of observations	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692
B: £115,000 threshold						
Taxable income elasticity	3.14***	0.46**	0.83***	0.83***	0.84***	0.14
Standard error	(0.176)	(0.181)	(0.191)	(0.191)	(0.191)	(0.208)
Linear base-year income control	No	Yes	Yes	Yes	No	No
Quadratic base-year income control	No	No	Yes	Yes	No	No
Cubic base-year income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	6,859	5,660	4,787	4,917	5,691	3,882
Number of observations	887,432	887,432	887,432	887,432	887,432	887,432

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Heteroscedasticity-robust standard errors. Income thresholds adjusted for CPI inflation over time.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

It is important to reiterate that this analysis relies heavily on the assumption that forestalling completely unwound by the end of 2011–12, and that no income was delayed from either 2010–11 or 2011–12 in anticipation of the reduction in the tax rate that occurred in 2013–14.[16] In Browne and Phillips (2016), we argue that around a third of the forestalling in 2009–10 had yet to be unwound by the end of 2011–12, suggesting that these taxable income elasticity estimates are biased downwards, as income in the 2009–10 to 2011–12 'post reform' period is still being artificially inflated by income having

2010–11 and 2011–12 (just after the reform). Using three year averages the effect is to *reduce* elasticities because stock market values *decreased* between the three year period 2006–07 to 2008–09 (pre–reform) and 2009–10 to 2011–12 (impacted by the reform).

[16] Our results would also give an unbiased estimate of the underlying elasticity if the amount of forestalling that had not unwound by the end of 2011–12 was equal to the amount of 'reverse forestalling' in 2010–11 and 2011–12.

been brought forward from 2012–13 and later years to 2009–10. But on the other hand it is possible that at least some income was delayed from 2011–12 to future years in anticipation of the reduction in the tax rate that occurred in 2013–14, which would bias the results in the opposite direction, though without any data from 2013–14 it is impossible to estimate the extent of this 'reverse forestalling'.

In other situations it would be possible to adapt our methodology to allow for the possibility that it took longer for forestalling to unwind by averaging over more years. In our case, however, the preannouncement of the reduction in the tax rate in March 2012 renders this impossible, since extending our post-reform period to include 2012–13 would mean that we were incorporating a year when we would surely expect a great deal of 'reverse forestalling' to occur, even if this was not an important issue in 2011–12.

IV.3. Analysis of those individuals with incomes around the £150,000 threshold

Our final methodology involves examining a group who we believe are not forestalling for whatever reason, namely those whose incomes are around the £150,000 threshold in 2009–10. Since forestalling involves artificially increasing one's income in 2009–10, those who took advantage of this opportunity to avoid paying the higher tax rate would presumably tend do have incomes significantly higher than £150,000 in 2009–10. Having an income only slightly higher than £150,000 in 2009–10 would suggest that an individual either was not engaging in forestalling (for whatever reason), or that they anticipated that their income would be less than £150,000 in subsequent years and so they would not be affected by the higher tax rate. Hence, estimates of elasticities for this group should be little affected by forestalling.

We therefore estimate similar models to those in section IV.1 (in other words, panel data models of one-year changes in income using the SA302 data from 1999–2000 to 2011–12) but restrict our sample to those with incomes between £70,000 and £200,000 in the base year. Note that if responsiveness differs between this group and those with incomes above £200,000, this analysis will not yield an estimate of the taxable income elasticity that we would want to use to estimate the revenue effects of the 50% tax rate, but rather the taxable income elasticity of those with incomes in the region of £150,000 (which is of interest in its own right). As in the previous two subsections, we show the sensitivity of our results to the base year income controls that we add to control for mean reversion, and as in section IV.1 we also use instruments suggested by Kopczuk (2005) and Weber (2014) based on income in t-2 and t-3, and test for the endogeneity of the base-year income instrument.

Table 7 shows these estimation results. In columns 1-3 we gradually add more base-year income controls. In column 4 we interact the 10-piece spline with stock market growth, so that we allow stock market growth to affect individuals at different income levels differently. In column 5, we add the instrument based on income in t-2, and t-2 dated controls: in particular we add a linear control for income in t-2, a ten-piece spline in income in t-2 and a ten-piece spline in income growth between t-2 and t-2. We interact each of these splines with stock market growth in period t. We then test for the exogeneity of the base-year income instrument using a difference-in-Sargan test, the results of which are also reported in the table. Column 6 reports results using only the instrument based on income in t-2. In column 7, we add the instrument based on income in t-3 and t-3 dated controls in a similar manner as in column 5 and again test the exogeneity of the base-year income instrument. In column 8, we drop the base-year income instrument and test the exogeneity of the instrument based on income in t-2. Finally, in column 9 we show results only using the instrument based on income in t-3.

We also vary the income cutoffs we use to select our sample, allowing the upper cutoff to range between £175,000 and £200,000 in panels A and B. Too low a cutoff will mean that we capture too few individuals affected by the 50% income tax rate, too high a cutoff will mean that our estimates are potentially affected by forestalling, biasing our

estimates of the underlying elasticity upwards. We also show a variant in panel C where we exclude those in the region of £150,000 to £175,000 as these individuals' responses may be attenuated by the fact that we would not expect individuals to reduce their incomes much below the £150,000 threshold in response to a higher tax rate that only applied above £150,000.

When we use the instrument based on incomes in the base year and control for mean reversion, we obtain taxable income elasticity estimates that are not statistically significantly different from zero in most cases, and which are in any case very small and not economically significant. However, the results of the difference-in-Sargan tests in column 7 clearly show that this instrument is endogenous, though interestingly we do not see this result in column 5 where we only have the instrument based on incomes in t-2 rather than both the instruments based on incomes in t-2 and t-3. A possible explanation for this is that the instrument based on incomes in t-2 is also endogenous: the difference-in-Sargan test we use tests the exogeneity of one instrument under the assumption that the others are exogenous. However, we see in column 8 that the exogeneity of the instrument based on incomes in t-2 is not rejected, and that the estimate of the taxable income elasticity does not change significantly when we use only the instrument based on incomes in t-3. When we add the instrument based on incomes in t-3, we find significantly higher taxable income elasticity estimates of between 0.1 and 0.2. At the very least, this suggests that those with incomes only slightly above the £150,000 threshold are less responsive to changes in their marginal tax rate than those with the very highest incomes.

However, there are two important caveats to these findings. First, those who have incomes only just above the £150,000 threshold have a relatively small utility loss from not changing their behaviour in response to the higher tax rate. If there are, as Chetty et al. (2012) argue, adjustment costs that mean it is not worthwhile for individuals to change their behaviour in response to small tax changes, our estimate of the taxable income elasticity is likely to be attenuated towards zero. If there were no adjustment costs, we would expect to observe bunching at the £150,000 threshold following the introduction of the new 50% tax rate. Browne (2017) investigates bunching at the £150,000 threshold and other kink points in the UK income tax system and finds little evidence of bunching. Furthermore, the bunching that does occur is concentrated among owner-mangers of incorporated businesses who have opportunities to respond to tax changes that might carry lower adjustment costs. In particular, Browne (2017) argues that their greater observed response is likely to be the result of shifting dividend payments between time periods to minimise tax liabilities rather than a change in real behaviour in response to the higher tax rate.

In addition, those with income just above the threshold in 2009–10 may not be representative of those affected; indeed, we know that they did not engage in forestalling whereas many others who knew that they would be affected by the higher tax rate the subsequent year did. It is possible that these individuals whose incomes were above £150,000 in 2009–10 but did not engage in forestalling anticipated that their incomes would fall in 2010–11 such that they would not be affected by the higher tax rate. Therefore, the reduction in income that we do observe amongst this group in 2010–11 could be the result of factors other than the higher tax rate that was introduced in that year. However, if those with incomes just above £150,000 in 2009–10 were not in fact affected by the higher tax rate that was introduced the subsequent year, this would show up in our results through the weakness of our instrument. In practice, our estimation is not affected by weak instrument problems (note the high F values on the first stage regression), tempering this concern.

TABLE 7

Results from panel data analysis around £150,000 threshold

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
A: £70,000 to £175,000 cutoffs									
Taxable income elasticity	0.030***	-0.006	-0.005	0.006	-0.010	0.019	-0.001	0.107***	0.158**
Standard error	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.040)	(0.011)	(0.038)	(0.076)
Linear base-year income control	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10-piece spline in base income	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spline interacted with stock market growth	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
t-2 dated variables	No	No	No	No	Yes	Yes	Yes	Yes	Yes
t-3 dated variables	No	No	No	No	No	No	Yes	Yes	Yes
Instrument based on base-year income	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Instrument based on income in t-2	No	No	No	No	Yes	Yes	Yes	Yes	No
Instrument based on income in t-3	No	No	No	No	No	No	Yes	Yes	Yes
p-value of difference-in Sargan test	N/A	N/A	N/A	N/A	0.452	N/A	0.003	0.426	N/A
F statistic on first stage	63,754	62,062	74,670	75,165	32,778	4,274	20,740	2,798	1,459
Number of observations	7,425,636	7,425,636	7,425,636	7,425,636	6,410,729	6,410,729	5,440,259	5,440,259	5,440,259
B: £70,000 to £200,000 cutoffs									
Taxable income elasticity	0.072***	0.018	0.016	0.033***	0.020*	0.057	0.028	0.142***	0.207***
Standard error	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.038)	(0.011)	(0.035)	(0.066)
Linear base-year income control	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10-piece spline in base income	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spline interacted with stock market growth	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
t-2 dated variables	No	No	No	No	Yes	Yes	Yes	Yes	Yes
t-3 dated variables	No	No	No	No	No	No	Yes	Yes	Yes
Instrument based on base-year income	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Instrument based on income in t-2	No	No	No	No	Yes	Yes	Yes	Yes	No
Instrument based on income in t-3	No	No	No	No	No	No	Yes	Yes	Yes
p-value of difference-in Sargan test	N/A	N/A	N/A	N/A	0.304	N/A	0.001	0.233	N/A
F statistic on first stage	68,346	66,270	77,301	77,365	34,096	5,551	21,765	3,488	2,133
Number of observations	7,831,652	7,831,652	7,831,652	7,831,652	6,773,270	6,773,270	5,758,706	5,758,706	5,758,706

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
C: Excluding region between £145,000 and £175,000									
Taxable income elasticity	0.039***	0.006	0.004	0.017	0.002	0.039	0.009	0.108***	0.127*
Standard error	(0.011)	(0.012)	(0.011)	(0.011)	(0.011)	(0.038)	(0.011)	(0.036)	(0.068)
Linear base-year income control	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10-piece spline in base income	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spline interacted with stock market growth	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
t-2 dated variables	No	No	No	No	Yes	Yes	Yes	Yes	Yes
t-3 dated variables	No	No	No	No	No	No	Yes	Yes	Yes
Instrument based on base-year income	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Instrument based on income in t-2	No	No	No	No	Yes	Yes	Yes	Yes	No
Instrument based on income in t-3	No	No	No	No	No	No	Yes	Yes	Yes
p-value of difference-in Sargan test	N/A	N/A	N/A	N/A	0.318	N/A	0.004	0.737	N/A
F statistic on first stage	59,166	57,755	68,510	68,680	29,995	4,941	19,082	3,049	1,818
Number of observations	7,041,877	7,041,877	7,041,877	7,041,877	6,071,543	6,071,543	5,143,720	5,143,720	5,143,720

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Income cutoffs adjusted for CPI inflation. Standard errors robust to heteroscedasticity.
Source: Authors' calculations using SA302 data from 1999–2000 to 2011–12.

IV.4. Summary

This section has utilised a number of panel approaches to estimating the taxable income elasticity, aimed at isolating longer-run responses from the temporary re-timing effects associated with forestalling behaviour. Unfortunately none of these methods allow us to estimate such an elasticity with much precision. Our analysis does, however, lead to some interesting conclusions.

First, the standard panel approach to estimating taxable income elasticities when there is potential for temporary timing effects – the use of longer panel intervals – does not properly address the problem of forestalling in this context, reflecting the fact that these temporary timing effects were still significant in our latest post-reform year of data (2011–12). With this in mind, we consider the estimates (reported in IV.2) based on averaging income over three years. This approach would correctly identify the elasticity if: the forestalled income brought forward into 2009–10 would otherwise have been reported in 2010–11 or 2011–12; there was no delay of income from these years (to 2013–14, for instance) in anticipation of the subsequent abolition of the 50% tax rate, and the usual common trends assumptions for difference-in-difference type analysis holds. While it is unlikely that any of these conditions hold exactly, they are more reasonable assumptions than there either being no impact of forestalling on incomes in 2011–12 (required for the standard panel approach of section IV.1) or the underlying responsiveness of those just over the £150,000 threshold to be similar to that of the full set of individuals with incomes over £150,00 (required for the approach of section IV.3).

Second, in each method used, estimates are sensitive to precise specification, confirming findings of multiple previous studies. This includes whether or not one includes controls for stock market growth, an important proxy for factors that may differentially affect the growth of those with highest incomes, i.e. the group subject to the 50% tax rate 'treatment'. While we can control for stock-market growth, this finding is an important reminder of how central the 'common trends' assumption is to taxable income elasticity estimates obtained from panel data. The fact that we find evidence that this assumption may not hold is a further reason to treat the estimates of the taxable income elasticity we do obtain cautiously.

Third, we find evidence that responses were highest for those with the highest incomes. Estimates based on unweighted data or among those with incomes close to the £150,000 threshold are consistently smaller than those based on full-sample income-weighted data.

Fourth, that even if the size of the underlying response is highly uncertain, when looked at in conjunction with the findings of our update of HMRC's analysis (Browne and Phillips (2016)) the panel analysis is highly suggestive of at least some underlying response to the 50% tax rate, and very large temporary timing responses. The next section examines the nature of this response in more detail.

V. The nature of behavioural response to the 50% tax rate

A common result in the previous literature (e.g. Gruber and Saez, 2002) is that much of the behavioural response to higher tax rates takes the form of increased use of tax shelters and deductions rather than genuine reductions in overall personal income. Income that is shifted in this way may be subject to taxation in other periods or in other tax bases such as capital gains tax or corporation tax. If income shifting does form part of the behavioural response to higher marginal tax rates, this has implications for the deadweight loss and revenue effects of the tax (see Saez et al., 2012 for a discussion).

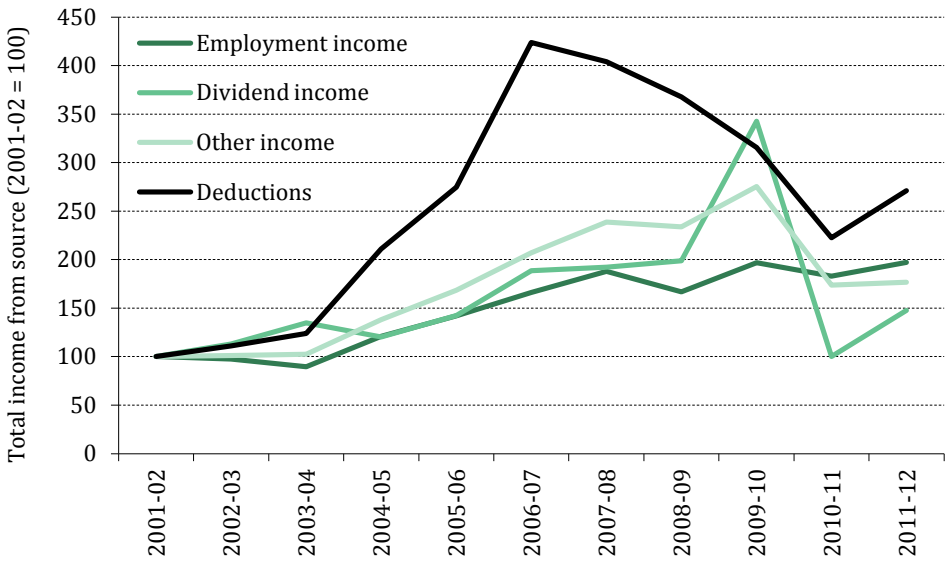
The previous literature has examined this possibility by investigating the impacts of tax changes on a broader measure of income, such as the total income of taxpayers before items such as pension contributions, losses and mortgage interest payments are deducted. Unfortunately, the data we have from self-assessment tax returns does not contain such a broad measure of income for most individuals. The most important deductible item for most individuals in the UK is pension contributions but for those whose pension scheme is arranged by their employer, contributions are deducted at source and so not included in the gross income measure recorded on the tax return. Nevertheless, we do observe many deductible items in the SA302 data including business losses, charitable donations, double taxation relief and contributions to private pensions not arranged by an employer. Furthermore, for a subgroup of people who have no income from employment (who are predominantly self employed), we are able to observe all deductions, including pension contributions.

Figure 6 below shows trends in these deductions observed in the SA302 data for the group with incomes above £150,000 between 2001–02 and 2011–12. We do not see any increase in deductions following the introduction of the higher income tax rate in 2010–11; indeed, deductions have if anything fallen more than income over the period in question.

It also shows that responses to the 50% tax rate were proportionally greatest for dividend income, and "other income" (which includes self-employment income), and more modest for employment income. The particularly sensitivity of capital income and self-employment income is typical of the literature (Blow and Preston (2002), Kleven and Schultz (2014)).

FIGURE 6

Trends in different income sources and deductions for group with incomes greater than £150,000, 2001–02 to 2011–12 (2001–02 = 100)



Source: Authors' calculations using SA302 data from 2001–02 to 2011–12.

Why might deductions have fallen at the same time there was an increase in incentives to use them (to avoid the higher 50% tax rate)? A possible reason is that other changes to the tax system introduced around the same period reduced the extent of deductable items for this group even as the higher tax rate encouraged individuals to increase their deductions. As we noted in Section II, the amount of tax-deductable pension contributions that individuals were allowed to make each

year was reduced from £255,000 to £50,000 in 2011–12. There were also related anti-forestalling measures in 2010–11 aimed at preventing taxpayers making large increases to their pension contributions that year in advance of the policy change in 2011–12. Both of these measures would have increased the taxable incomes of those who would otherwise have wished to save more than £50,000 in a pension each year. It also limits the extent to which individuals were able to respond to the 50% tax rate by increasing their pension contributions to reduce their taxable income. A further motivation for examining broad income responses therefore is that our measure of taxable income will be affected by these changes in pension contribution limits in a way that the broad income measure will not.

In Table 8, we therefore estimate broad income elasticities (that is, the responsiveness of broad income to changes in the net-of-tax rate) using the three-year average method described in section IV.2. We re-estimate equation (2) changing the outcome variable from the change in taxable income averaged over a three-year period to the change in broad income. Table 8 shows the results of these regressions: as in Table 6, we gradually add more base-year income controls as we move from left to right across the table, and in column 6 we interact the spline with stock market growth between the two three-year periods to allow this to have different effects at different income levels. As in Table 6, we weight by taxable income in the base period: unweighted estimates can be found in Table A3 in Appendix A.

Unlike other estimates from the literature, our estimates of broad income elasticities are significantly higher than our estimates of taxable income elasticities. For all models that control for mean reversion in some way, the estimates in Table 8 are between 0.28 and 0.54 larger than the estimates from the equivalent models in Table 6, suggesting that deductions fell more than taxable income in response to the higher tax rate, a slightly implausible result. The most plausible explanation for this would seem to be that the decision to restrict the amount of pension contributions that were eligible for tax relief increased taxable income in 2010–11 and 2011–12 reduced the amount of deductions that individuals were able to take, increasing the amount of taxable income. Many individuals were making pension contributions of more than £50,000 a year prior to this change and so would have been obliged to reduce their deductions and increase their taxable income in 2011–12 in any case, meaning that our taxable income elasticity estimates are incorrectly attributing increases in taxable income resulting from reductions in pension contributions to the change in the tax rate, when in fact these would have happened anyway.

Our estimates of the broad income elasticity are relatively large compared to others estimated in the literature and might indicate that the response to the higher tax rate took the form of a genuine reduction in income. This would imply a large deadweight cost of taxation, and a lack of fiscal externalities whereby tax revenues lost in the short term could be recouped later or via other tax bases. In such circumstances it would be arguable that our broad income elasticity estimates would be more appropriate to assess the revenue effects of the 50% tax rate. Use of the preferred estimate of the broad income elasticity of 0.71 would imply a revenue-maximising marginal rate of tax of (including NICs and possibly consumption taxes) of 45%. It would also imply that the 50% tax rate would reduce revenues by around £1.75 billion compared to a 45% rate, assuming no revenues were recouped from other tax bases or in subsequent years.

However, it is important to add a note of caution: as stated above, we do not observe all deductions in our SA302 data, so our measure of 'broad' income is not as broad as those of other researchers. It is possible that other deductible items that we do not observe in our data, such as pension contributions made by employees or

employers, increased in response to the higher tax rate. If this were the case our estimate of the broad income elasticity (based on a subset of tax deductions) would be an over-estimate of the true broad income elasticity (based on the full set of tax deductions).

TABLE 8

Broad income elasticities calculated using change in income averaged over three years

	(1)	(2)	(3)	(4)	(5)	(6)
A: £70,000 threshold						
Broad income elasticity	2.45***	0.76***	1.15***	1.20***	1.19***	0.71***
Standard error	(0.080)	(0.096)	(0.099)	(0.098)	(0.099)	(0.113)
Linear base-year income control	No	Yes	Yes	Yes	No	No
Quadratic base-year income control	No	No	Yes	Yes	No	No
Cubic base-year income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	14,078	9,369	7,861	7,833	7,860	5,987
Number of observations	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692
B: £115,000 threshold						
Broad income elasticity	2.83***	0.89***	1.17***	1.19***	1.19***	0.68***
Standard error	(0.150)	(0.169)	(0.175)	(0.174)	(0.174)	(0.191)
Linear base-year income control	No	Yes	Yes	Yes	No	No
Quadratic base-year income control	No	No	Yes	Yes	No	No
Cubic base-year income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	4,058	3,105	2,742	2,747	2,747	2,335
Number of observations	887,432	887,432	887,432	887,432	887,432	887,432

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Heteroscedasticity-robust standard errors. Income thresholds adjusted for CPI inflation over time.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

To investigate this question more fully, we can examine the behaviour of those for whom we are confident of seeing all pension contributions: namely those who report no income from employment (and thus by definition cannot be part of an employer-run pension scheme). Most of these individuals (around 350,000 out of 450,000) are self-employed. Within this group, we can restrict our sample further to those whose pension contributions are relatively low (we use a cutoff of an average of £20,000 a year or less in the base period) as these individuals are less likely to be affected by the change to pension contribution limits.

Table 9 shows estimates of taxable and broad income elasticities for each of these groups. In column (1), we apply the regression techniques used in column (6) of Tables 6 and 8 (i.e. our model of three-year average incomes with a spline that is interacted with stock market growth) and examine all of those who report no employment income in the base period. In column (2) we restrict our sample to those who report less than £20,000 of pension contributions per year and show the estimates from the model estimated in column (1) for this group. In column (3),

we again add a spline in base-period pension contributions to the model. As before, we show results with a lower income cut-off of £70,000, and a lower income cutoff of £115,000: in this case, there is little difference except that standard errors are larger when we use the smaller sample. We again weight observations according to their pre-reform taxable or broad income; results using unweighted data are available in Table A4 in the Appendix.

We can see that when we look at the whole population of those without any employment income we again obtain the result that the taxable income elasticity is smaller than the broad income elasticity. This is likely because those who previously would have contributed more than £50,000 a year to their private pensions were forced to reduce their contributions in 2011–12. When we restrict the sample to those whose pension contributions averaged less than £20,000 a year in the pre-reform period, and were thus less likely to be affected by this restriction, this reverses however. Nevertheless, our estimates of the broad income elasticity are not significantly (in either a statistical or economic sense) lower than those of the taxable income elasticity: increasing tax deductions did not seem to be a significant way in which these individuals responded to the higher income tax rate.[17]

TABLE 9

Taxable and broad income elasticities calculated using three-year changes in income, only those without any employment income

A: Income cutoff of £70,000			
	(1)	(2)	(3)
Taxable income elasticity	0.77***	1.07***	0.91***
Standard error	(0.178)	(0.222)	(0.220)
Broad income elasticity	0.93***	1.02***	0.88***
Standard error	(0.180)	(0.196)	(0.194)
Spline in base-period pension contributions	No	No	Yes
Sample restricted to those with less than £20,000 of pension contributions?	No	Yes	Yes
F statistic on first stage (taxable income elasticity)	4,461	2,164	2,182
F statistic on first stage (broad income elasticity)	1,928	756	801
Number of observations	450,737	211,363	211,363
B: Income cutoff of £115,000			
Taxable income elasticity	0.84**	1.08***	0.88*
Standard error	(0.399)	(0.480)	(0.472)
Broad income elasticity	1.16***	1.02***	0.83**
Standard error	(0.349)	(0.392)	(0.384)
Spline in base-period pension contributions	No	No	Yes
Sample restricted to those with less than £20,000 of pension contributions?	No	Yes	Yes
F statistic on first stage (taxable income elasticity)	1,033	561	452
F statistic on first stage (broad income elasticity)	518	166	181
Number of observations	189,483	88,380	88,380

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Heteroscedasticity-robust standard errors. Income thresholds adjusted for CPI inflation over time.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

Finally, we can also examine which types of income were particularly responsive to the change in the tax rate. In Table 10, we examine the elasticity of employment, dividend and other income to the net-of-tax rate. As in Table 9, we

[17] Of course, it may be possible that the responses of these individuals are not typical: they may have a low taste for pension contributions in the first place, so might be less likely to respond in that way that other groups would have done had they been able to do so)

only estimate models with a spline in income that is interacted with stock market growth and again estimate models with a lower average income cutoff of £70,000 and a lower cutoff of £115,000. In each case we weight the regression by the income the individual has from that source in the base period. We see that our results are driven by income sources other than employment or dividends. It is unsurprising that the elasticity of employment income with respect to the net-of-tax rate is not significantly different from zero, as we saw in Figure 6 that this income source fell less overall following the introduction of the 50% tax rate in 2010–11. However, we did see a big reduction in dividend income. It seems likely that dividend income is too volatile from year to year for this to be picked up by the three-year averaging method being used here, and hence the elasticity of dividend income with respect to the net-of-tax rate is measured very imprecisely. As in our previous analysis, we weight the data according to individuals' incomes in the base period, and report results using unweighted data in Table A5 in Appendix A.

TABLE 10

Elasticities of employment, dividend and other income calculated using change in three-year average income, only those without any employment income

A: Income cutoff of £70,000			
Income source	Employment	Dividends	Other
Taxable income elasticity	-0.31*	-1.03	0.95***
Standard error	(0.160)	(0.945)	(0.201)
F statistic on first stage (broad income elasticity)	7,941	368	2,121
Number of observations	1,315,950	1,125,764	1,653,853
B: Income cutoff of £115,000			
Taxable income elasticity	-0.42	-0.53	0.91***
Standard error	(0.285)	(1.384)	(0.351)
F statistic on first stage (broad income elasticity)	2,690	201	725
Number of observations	650,687	549,417	795,247

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Heteroscedasticity-robust standard errors. Income thresholds adjusted for CPI inflation over time.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

VI. Discussion and conclusions

In this paper, we have made use of newly-available panel data on UK income taxpayers to investigate the responses of high-income individuals to the introduction of a 50% income tax rate applying above £150,000. Estimating parameters of interest such as the taxable income elasticity has been impeded by the fact that the increase in the tax rate was announced more than a year in advance, meaning that many individuals were able to take advantage of the opportunity to reduce their tax liabilities by shifting income forward to the year before the higher tax rate was introduced.

We first estimated standard panel regression, comparing individuals' annual incomes one, two and three years apart. We found that our taxable income elasticity estimates exhibited very high sensitivity to the precise specifications used to control for problems of mean-reversion, and which in many cases – including those controlling for stock market growth – are much higher than is usually found in the literature. This suggests that this approach may not properly deal with the problem of forestalling behaviour. Our unweighted analysis produces estimates more in line with results from the literature but if those with the very highest incomes are the most responsive to changes in marginal tax rates, we would expect, all else equal, that the appropriate elasticity for calculating the yield of the 50% rate to be higher than unweighted estimates.

In order to better control for the problem of forestalling confounding our taxable income elasticity estimated, we have also estimated panel regression models where we average individuals incomes over three-year periods. Under the assumption that all the income brought forward to 2009–10 came from either 2010–11 or 2011–12, the average income over the three year period would be unaffected by forestalling, meaning that these models would produce an estimate of the underlying elasticity. These again show considerable sensitivity to the specification used, but produce an estimate of 0.31 under our preferred specification, which would imply revenues under the 50% rate being £1 billion higher than under a 45% rate. This is a smaller estimate of the taxable income elasticity than the central estimate of HMRC (2012), though their estimate of 0.48 is not statistically significantly different to ours (and neither are the resulting estimates of revenue effects).

Moreover, there are reasons to believe that this is an underestimate of the true elasticity. First, in a companion paper (Browne and Phillips, 2017) we show that the assumption that forestalling unwinds by the end of 2011–12 does not appear to have held in practice when we examine the behaviour of those who had stable incomes in the years before the tax rate was increased: around of the forestalling remained to be unwound after 2011–12. Second, when we examine a broader measure of income before certain items are deducted, we find, contrary to the results of many other papers in the literature, that the broad income elasticity for this group is significantly higher than the taxable income elasticity: 0.71 in our preferred specification. This is likely because of a change that was introduced alongside the higher tax rate which reduced the amount individuals could contribute to tax-favoured pension schemes: as some individuals were previously contributing more than this limit, this change would have increased their taxable incomes independently of any changes in the tax rate. Our estimates of the taxable income elasticity erroneously attribute this increase in taxable incomes to the change in the tax rate, biasing our estimate of the taxable income elasticity downwards.

An elasticity of 0.71 would imply that the revenue-maximising top income tax rate was well below 40%, let alone 50%, in the case where all of the response was a real response. Even in the case where half of the response represented income shifting to another tax base (for example, capital gains) where the tax rate was, say, 20%, the revenue-maximising rate of income tax rate would be below 50% (given prevailing rates of NICs and consumption taxes).

However, we find little evidence that the reduction in taxable income observed was the result of individuals increasing deductable items that might create ‘fiscal externalities’ in other bases or time periods in response to the higher tax rate. This must be a tentative conclusion though as not all deductable items are recorded in the SA302 data, and there are possible responses that would create ‘fiscal externalities’ that do not involve increasing deductions. For example, it is possible that owners of closely-held incorporated businesses chose to respond to the higher tax rate by retaining income in their business, to be paid out in dividends later, or to be realised in the form of capital gains (subject to capital gains tax rather than income tax) when shares in the business are sold. Neither of these responses would be picked up in an analysis of short-term personal income tax returns. If these responses were significant, our estimates could be overstating the long-term revenue costs associated with behavioural response: income tax revenues lost upfront may be recouped when dividends are paid or capital gains realised subsequently. The linking of personal income tax data with corporate income tax returns and accounts would allow investigation of this research and should therefore be a priority for research.

There are also other reasons why this higher estimate might be too large: as well as income being brought forward from years beyond 2011–12 to 2009–10 to avoid paying the higher tax rate, individuals may also have delayed receiving income from 2010–11 or 2011–12 having (correctly) anticipated that the 50% rate might subsequently be reduced.

Finally, we have analysed the responses of those around the £150,000 threshold to the introduction of the higher tax rate. This yields the most consistent results in our paper, and shows a smaller elasticity in the region of 0.1 to 0.2. This implies that most of the overall response to the higher tax rate occurred among those with the very highest incomes. It also suggests that a potential source for increasing revenue further would be to reduce the threshold at which the top tax rate applies, as the group who would see their marginal tax rate increase as a result of this are relatively unresponsive.

To conclude then, despite significant uncertainty surrounding estimates, it seems likely – albeit far from certain – that the taxable income elasticity for the highest-income 1% of individuals as a whole is of roughly the same order of magnitude as in the 1980s, despite efforts of successive governments to clamp down on tax avoidance among this group. Why might this be? Most obviously it might reflect the fact that underlying responsiveness of taxable income among high income individuals has increased, possibly as a result of globalisation: a greater fraction of high income individuals are from overseas, presumably meaning they are more internationally mobile, and more easily able to respond by shifting income offshore. However, it may also reflect other changes in the tax system and/or the type of income earned by high income individuals. Increased use of corporate structures following reductions in corporation tax and increases in social security contribution rates (see, for example, Crawford and Freedman, 2010) has also meant that there is increased scope for high-income individuals to shift their income between different time periods using retained corporate earnings in order to minimise their tax liabilities (see Browne, 2017), confounding attempts to identify short-run responses to changes in tax rates.

In methodological terms, the analysis confirms the importance of controlling for mean reversion adequately in panel analysis. We have allowed the extent of mean reversion to vary depending on stock market growth, as it is clear from our analysis that the incomes of the very richest individuals in the UK are more sensitive to stock market growth than are the incomes of other groups. We have also seen that standard approaches to dealing with forestalling, namely increasing the gap between the 'before' and 'after' periods, does not always deal with the problem when several years' income is brought forward in anticipation of a higher tax rate. Our novel approach of averaging incomes over several years is perhaps a better way of dealing with the problem, though to work best it requires policy stability following the reform and a long panel dataset preceding the reform, neither of which is available to us. Exploiting this methodology more fully remains an avenue for further research.

Finally, returning to the policy question that motivated this analysis, it has not proved possible to produce a definitive estimate of the taxable income elasticity of those affected by the 50%, nor narrow down estimates of the revenue effect of the 50% tax rate. The preferred estimates of the taxable income elasticity (0.31) and broad income (0.71) elasticities obtained here would imply a 50% tax rate could raise around £1 billion a year or cost around £1.75 billion a year, respectively, compared to the current 45% rate in place. HMRC's estimate of 0.48 – which itself would suggest little change to revenues if the 50% rate were restored –, is within the range of uncertainty of both estimates and therefore represents a reasonable (although uncertain) estimate for use in official policy costings (despite methodological issues with that analysis, discussed in Browne and Phillips, 2017).

The particular difficulties encountered in updating estimates of the taxable income elasticity following the introduction of the 50% rate (and associated difficulties with costing this policy change) reflect the pre-announcement of this policy, giving affected individuals over a year to bring forward part of their income (potentially in collusion with their employers) to 2009–10 to avoid the higher tax rate. The pre-announcement of the reduction in the 50% rate to 45% from April 2013 means that estimation of the underlying taxable income elasticity using this cut would also likely prove very challenging. If subsequent changes to the taxation of high income individuals were announced with immediate (or near-immediate) effect, this would limit the ability of individuals to re-time their income, making the subsequent estimation of the underlying taxable income elasticity and the revenue effects of the reform more straight-forward. From the government's perspective such immediate announcements would also have the benefit of maximising tax revenues – individuals would have less ability to minimise their tax liabilities by re-timing their incomes. The flip side of the coin is that immediate announcement may limit the extent to which policy can be properly debated before it is introduced. Policymakers may therefore need to decide whether they wish to prioritise scrutiny in the form of better estimates of the effects of policies (which is easier without pre-announcement) or scrutiny in the form of parliamentary and public debate (which is easier if reforms are pre-announced).

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Appendix A: Results of unweighted panel analysis

TABLE A1

Panel estimates of the taxable income elasticity, unweighted, Kopczuk method

	Number of years between t-1 and t			
	1	**2**	**3**	**3***
All individuals > £115k				
No controls	-0.244	-0.278	-0.458	-0.537
	(0.059)	(0.060)	(0.069)	(0.101)
Linear controls	0.569	0.779	0.463	0.540
	(0.066)	(0.086)	(0.107)	(0.180)
Quadratic controls	0.473	0.718	0.432	0.467
	(0.065)	(0.085)	(0.107)	(0.179)
Cubic controls	0.523	0.788	0.507	0.559
	(0.067)	(0.089)	(0.110)	(0.183)
Spline	1.098	1.514	1.695	1.385
	(0.070)	(0.096)	(0.128)	(0.201)
Spline interacted with stock growth	1.279	1.741	1.676	1.488
	(0.073)	(0.103)	(0.128)	(0.209)
All individuals > £70k				
No controls	0.269	0.158	0.149	0.092
	(0.027)	(0.024)	(0.027)	(0.040)
Linear controls	0.432	0.247	0.110	0.070
	(0.030)	(0.031)	(0.038)	(0.060)
Quadratic controls	0.401	0.284	0.190	0.152
	(0.030)	(0.031)	(0.039)	(0.062)
Cubic controls	0.437	0.320	0.240	0.228
	(0.031)	(0.032)	(0.040)	(0.064)
Spline	0.725	0.624	0.769	0.581
	(0.031)	(0.032)	(0.041)	(0.063)
Spline interacted with stock growth	0.880	0.820	0.739	0.635
	(0.032)	(0.035)	(0.041)	(0.064)
Memo: HMRC estimate	0.48	n/a	n/a	n/a

Note: Standard errors are in parentheses. 3* regressions include no overlapping 3 year panels.
Source: Authors' calculations using SA302 data from 1999–00 to 2011–12.

TABLE A2

Taxable income elasticities calculated using three-year changes in income, unweighted

	(1)	(2)	(3)	(4)	(5)	(6)
A: £70,000 threshold						
Taxable income elasticity	1.88***	1.17***	1.45***	1.48***	1.46***	1.35***
Standard error	(0.046)	(0.056)	(0.060)	(0.061)	(0.061)	(0.071)
Linear base income control	No	Yes	Yes	Yes	No	No
Quadratic base income control	No	No	Yes	Yes	No	No
Cubic base income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	39,014	24,477	22,540	22,299	22,454	16,611
Number of observations	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692
B: £115,000 threshold						
Taxable income elasticity	2.83***	1.29***	1.53***	1.55***	1.56***	1.22***
Standard error	(0.115)	(0.124)	(0.131)	(0.132)	(0.134)	(0.150)
Linear base income control	No	Yes	Yes	Yes	No	No
Quadratic base income control	No	No	Yes	Yes	No	No
Cubic base income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	8,626	6,163	5,794	5,770	5,691	4,433
Number of observations	887,432	887,432	887,432	887,432	887,432	887,432

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Cutoffs in constant 2010–11 prices.

Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

TABLE A3

Broad income elasticities calculated using three-year changes in income, unweighted

	(1)	(2)	(3)	(4)	(5)	(6)
A: £70,000 threshold						
Taxable income elasticity	1.90***	1.33***	1.61***	1.64***	1.63***	1.50***
Standard error	(0.045)	(0.055)	(0.059)	(0.059)	(0.060)	(0.070)
Linear base income control	No	Yes	Yes	Yes	No	No
Quadratic base income control	No	No	Yes	Yes	No	No
Cubic base income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	39,014	24,477	22,540	22,299	22,454	16,611
Number of observations	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692	1,872,692
B: £115,000 threshold						
Taxable income elasticity	2.91***	1.54***	1.79***	1.82***	1.82***	1.19***
Standard error	(0.111)	(0.121)	(0.128)	(0.129)	(0.130)	(0.174)
Linear base income control	No	Yes	Yes	Yes	No	No
Quadratic base income control	No	No	Yes	Yes	No	No
Cubic base income control	No	No	No	Yes	No	No
20-piece spline in base income	No	No	No	No	Yes	Yes
Spline interacted with stock market growth	No	No	No	No	No	Yes
F statistic on first stage	8,629	6,163	5,794	5,770	5,691	2,747
Number of observations	887,432	887,432	887,432	887,432	887,432	887,432

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Cutoffs in constant 2010–11 prices.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

TABLE A4

Taxable and broad income elasticities calculated using three-year changes in income, only those without any employment income, unweighted data

A: Income cutoff of £70,000			
	(1)	(2)	(3)
Taxable income elasticity	1.47***	1.79***	1.69***
Standard error	(0.129)	(0.211)	(0.207)
Broad income elasticity	1.53***	1.63***	1.55***
Standard error	(0.121)	(0.184)	(0.181)
Spline in base-period pension contributions	No	No	Yes
Sample restricted to those with less than £20,000 of pension contributions?	No	Yes	Yes
F statistic on first stage (taxable income elasticity)	4,653	1,752	1,773
F statistic on first stage (broad income elasticity)	4,653	1,752	1,773
Number of observations	450,737	211,363	211,363
B: Income cutoff of £115,000			
Taxable income elasticity	2.40***	1.94***	1.76***
Standard error	(0.357)	(0.479)	(0.466)
Broad income elasticity	2.57***	1.86***	1.69***
Standard error	(0.334)	(0.413)	(0.401)
Spline in base-period pension contributions	No	No	Yes
Sample restricted to those with less than £20,000 of pension contributions?	No	Yes	Yes
F statistic on first stage (taxable income elasticity)	850	445	452
F statistic on first stage (broad income elasticity)	850	445	452
Number of observations	189,483	88,380	88,380

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Heteroscedasticity-robust standard errors. Income thresholds adjusted for CPI inflation over time.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.

TABLE A5

Elasticities of employment, dividend and other income calculated using change in three-year average income, only those without any employment income, unweighted data

A: Income cutoff of £70,000			
Income source	Employment	Dividends	Other
Taxable income elasticity	0.226***	-3.62***	0.45***
Standard error	(0.073)	(0.148)	(0.141)
F statistic on first stage (broad income elasticity)	15,419	11,716	14,276
Number of observations	1,315,950	1,125,764	1,653,853
B: Income cutoff of £115,000			
Taxable income elasticity	-0.16	-4.55***	0.71***
Standard error	(0.144)	(0.287)	(0.275)
F statistic on first stage (broad income elasticity)	4,408	3,396	3,816
Number of observations	650,687	549,417	795,247

Note: *** indicates statistically significantly different from zero at 1% level, ** statistically significantly different from zero at 5% level, * statistically significantly different from zero at 10% level. Heteroscedasticity-robust standard errors. Income thresholds adjusted for CPI inflation over time.
Source: Authors' calculations using SA302 data from 2000–01 to 2011–12.