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Working paper
21/49

Intertemporal income shifting and the taxation of business owner-managers

Economic and Social Research Council

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December, 2021

Abstract

We use newly linked tax records to show that the large responses of UK company owner-managers to personal taxes are due to intertemporal income shifting and not to reductions in real business activity. Around half of this shifting is short-term and helps prevent volatile incomes being taxed more heavily under progressive personal taxes. The remainder reflects systemic profit retention over long periods to take advantage of lower tax rates, including preferential treatment of capital gains. We find no evidence that this tax-induced retention increases business investment. It does, however, substantially reduce the tax revenue raised from high income business owners.

Keywords: income shifting, elasticity of taxable income, owner-managers, closely held business, dividend taxation, capital gains
JEL classification: H30, H24, H26, D25
Acknowledgements: We thank William Boning, Richard Blundell, Michael Devereux, Eric French, Rachel Griffith, John Eric Humphries, Henrik Kleven, Rory McGee, Costas Meghir, Martin O'Connell, Aureo de Paula, Max Risch, Emmanuel Saez, Joel Slemrod and Eric Zwick for helpful comments. We gratefully acknowledge financial support from the Economic and Social Research Council (ESRC) under the Centre for the Microeconomic Analysis of Public Policy (CPP), grant number RES-544-28-0001 and under the Tax Administration Research Centre, grant number ES/K005944/1, and under grant number ES/T001488/1. All errors and omissions remained the responsibility of the authors. This work contains statistical data from HMRC which is Crown Copyright. The research datasets used may not exactly reproduce HMRC aggregates. The use of HMRC statistical data in this work does not imply the endorsement of HMRC in relation to the interpretation or analysis of the information.

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1 Introduction

The taxation of business owners is important – they are a growing part of the workforce,[1] and how they respond to tax is key for assessing the efficiency and equity properties of capital taxation. Politicians commonly grant business owner-managers preferential tax treatment as a means to boost entrepreneurship and growth. The policies chosen – for example, favourable capital gains tax rates – often incentivise the shifting of taxable income across time. Such shifting can allow individuals to smooth tax payments when incomes are volatile but can also create inefficiencies and reduce government revenue.

The contribution of this paper is to study different forms of intertemporal income shifting and their implications for tax avoidance and capital allocation, in a setting of considerable policy interest. Previous work has shown that business owners are responsive to taxes, and that this is often driven by avoidance, notably through income shifting across tax bases[2] and time.[3] We use newly linked personal and corporate tax records to show that all of the responsiveness of UK company owner-managers to marginal tax rate changes is due to intertemporal income shifting, and not to reductions in real business activity. We show that around half of shifting is short-term and helps prevent volatile incomes being taxed more heavily under progressive personal taxes. However, the remainder reflects systemic retention of profits within a company over long periods in order to access lower capital gains tax rates. We show that this tax-induced systematic profit retention does not increase investment in business capital; retained profits are held in financial assets. Older and higher income individuals are more likely to retain profits, with profit retention significantly reducing the tax liability of the highest profit owner-managers.

In the UK, as in many European countries, the corporate form is tax-advantaged both because capital income is taxed at lower rates than labour income and because

[1] In the US, the share of total business income accruing to "pass-through entities" rose from 21% in 1980 to over 50% by 2011 (DeBacker and Prisinzano (2015)) In the UK, company owner-managers have been the fastest growing part of the labour force since the early 2000s (Cribb et al. (2019)).

[2] This includes tax-motivated incorporation (e.g. Gordon and MacKie-Mason (1994, 1997), Goolsbee (1998), Gordon and Slemrod (2000)) and the relabelling of labour income as capital income (Gordon and Slemrod (2000), Harju and Matikka (2016)).

[3] e.g. le Maire and Schjerning (2013), Alstadsæter and Fjærli (2009), Alstadsæter et al. (2014).

business owners can choose when to withdraw income from the company and pay personal income taxes.[4] To empirically distinguish between the ways that UK company owner-managers respond to tax changes, we use a new match between the personal tax records of individuals who are major shareholders and directors of incorporated businesses and the associated company's corporate tax records. This allows us to distinguish between the total income created each year by the owner-manager (measured at the business level), personal taxable income paid to the owner-manager and the net retention of profits in the company.

Owner-managers face a progressive personal tax schedule and can access a preferential capital gains tax rate if they retain profits until liquidation. These tax features provide two different incentives to shift taxable income across time. First, individuals whose profit fluctuates around kinks in the tax schedule can retain when profits are high and withdraw when profits are low to avoid paying the higher rate. It is well understood that people will save and dissave to smooth consumption in the face of income fluctuations. However, we highlight that shifting in this case (which corresponds to saving in the company) exists because of the variation in tax rates that individuals face as their profit fluctuates. The second form of intertemporal income shifting is the systematic retention of profits within the company to take advantage of the fact that the tax rate faced at liquidation is lower than the rate faced during company life. Owner-managers may also respond to personal taxes by changing investment and labour supply.

We use two complementary empirical approaches that exploit different forms of tax variation to show that all of the responsiveness of owner-managers to tax rate changes is due to intertemporal income shifting and not reductions in real business activity. First, we use a bunching estimator[5] applied to different income measures around the higher rate threshold, above which the marginal personal income tax rate increases by 20 percentage points. We show that while there is sharp bunching in *taxable (personal) income*, there

[4]In many European countries, corporate forms that provide vehicles for intertemporal income shifting have been the most tax advantaged form of business ownership and incorporation the source of most business growth for decades (de Mooij and Nicodème (2008)).

[5]As developed by Saez (2010) and Chetty et al. (2011); see Kleven (2016) for a summary.

is no evidence of any bunching in the *total income at the company level*.[6] This indicates that the bunching in taxable income is entirely driven by strategic profit retention and withdrawal. Second, we find similar patterns using a difference-in-differences approach to assess responses to policy reforms that increased marginal tax rates on incomes above £100,000. There were large responses in taxable income but no evidence of a change in the total amount of income generated, even 5 years after the reforms. Company owner-managers face significantly fewer constraints on their labour supply choices than other types of workers, such that the attenuating effects of adjustment costs on estimated labour supply elasticities are less of a concern.[7]

We empirically study the different motivations for intertemporal income shifting by exploiting the panel nature of the tax records. We argue that those who are smoothing volatile total incomes in the face of tax kinks will not bunch in all years. This is supported by the fact that, on average, net retention is zero for these "sometimes bunchers", and we see them retaining when their incomes are high and withdrawing when their incomes are low. In contrast, we argue that those who bunch consistently are systematically retaining to access lower future rates; in line with this, such individuals accumulate positive net retained profits. We find that around half of the observed bunching at the higher rate threshold is due to shifting to smooth volatility. The ability to engage in this short-run form of shifting is beneficial as it allows individuals with volatile incomes to smooth their tax liability and not be penalised by a progressive tax schedule, relative to individuals with more stable incomes (Meade (1978), Bradford (1982)).

Much of the existing literature on intertemporal income shifting focuses on short-run responses.[8] However, there is also evidence of substantial, systematic profit retention to take advantage of lower future tax rates. The incentive for UK owner-managers to retain over long periods exists largely as a result of "Entrepreneurs' Relief", a 10% capital gains

[6]We may not expect to see bunching in annual total income if it is volatile and individuals can easily shift income across time. Following the approach of le Maire and Schjerning (2013) we consider bunching in average total income but find no evidence of this.

[7]See, for example, Chetty et al. (2011), Kleven and Waseem (2013), Bastani and Selin (2014).

[8]Goolsbee (2000) finds that the taxable income response of executives to tax rises disappears after one year. le Maire and Schjerning (2013) study short-run shifting by the Danish self-employed.

tax rate for gains realised on shares in closely held companies.[9] We find that owner-managers retain substantial sums over several years – among those generating £150,000 of total income, half retain in excess of £50,000 each year and 25% retain more than £90,000. However, owner-managers almost never retain to the tax minimising extent, which suggests that there are costs to doing so. Most likely, individuals cannot fully and costlessly borrow at the personal level against income retained in the company for long periods, and, as a result, the intertemporal allocation of consumption is distorted. In support of the existence of these costs, we find that profit retention is higher for individuals closer to retirement age.

Policy makers often perceive a trade-off when setting capital taxes: because capital incomes accrue disproportionally to high earners, higher rates are desirable for redistributive reasons, but they can generate large efficiency losses if they reduce savings and investments (Chetty and Saez (2005)). The rationale for "Entrepreneurs' Relief" is to boost closely held business investment. We argue that preferential capital gains tax rates increase the incentive to retain earnings in a company but do not directly change investment incentives; capital investment will only change if higher retained earnings affect the asset portfolio choice within the business.[10] Empirically, we find that retained profits are held in the form of cash and other equivalent financial assets and lead to no change in a company's capital stock, even among those companies that do have significant capital holdings.[11] At the same time, lower capital gains tax rates are costly in terms of foregone revenue and provide disproportionate benefit to the highest income business owners: among owner-managers claiming Entrepreneurs' Relief, mean capital gains are £500,000, corresponding to a tax saving (relative to taxation on accrual) of £75,000 over the company's life.[12]

[9]The UK government's March 2020 Budget reduced the lifetime amount of gains eligible for Entrepreneur's Relief from £10 million to £1 million and renamed it Business Asset Disposal (BAD) relief.

[10]We do not study business entry in this paper, but note that preferential tax rates for business owners are similarly poorly targeted on this margin and can lead to tax-motivated incorporation (Crawford and Freedman (2010)).

[11]This is consistent with the 'new view" of dividend taxes (changes in rates of dividend taxes do not affect the incentive to invest out of retained earnings (Auerbach (1979), Bradford (1981))) and evidence that the 2003 US dividend tax cut did not led to increased investment (Yagan (2015)).

[12]Advani and Summers (2020) show that preferential rates of tax on capital incomes lead to average tax rates falling at the very top of the UK income distribution. Smith, Zidar, and Zwick (2019) highlight

There is a growing literature, dating back to Feldstein (1995, 1999), which uses the elasticity of taxable income (ETI) to estimate the marginal welfare change from raising tax rates. However, the conditions under which this is valid are known to break down if there are spillovers to other tax bases (Slemrod (1995), Slemrod and Yitzhaki (2002)). We show that there is substantial bunching at tax kinks by owner-managers; Adam et al. (2017) estimate the elasticity of taxable income of this group of around 0.1 (compared to 0 for employees). However, we show that this is entirely driven by shifting income across time, which means that it will be taxed *at some point*. Failure to account for these intertemporal spillovers would thus lead to an overestimate of the deadweight loss of tax (see, for example, Chetty (2009)).[13]

The key institutional features of our setting – notably the tax advantage associated with the corporate form, the freedom to decide when income is taxed at the personal level and the preferential rate of capital gains tax for businesses assets – are common across, and therefore of interest in, many tax systems. This includes the US: the 2017 Tax Cuts and Jobs Act reduced the US corporate tax rate and is likely to lead more US owner-managers to choose a C-corporation form (Looney (2017)). This legal form offers a means to shift income intertemporally and the exemption of qualified small business stock from US capital gains tax provides an incentive to do so.[14]

In the next section we describe the data, and in Section 3 we outline the institutional setting and tax incentives faced by owner-managers. In Section 4 we present our empirical results, and a final section concludes and discusses the implications of our findings.

2 Data

Our population of interest are UK owner-managers of "closely held" companies i.e. company directors (managers) who are also major shareholders (owners), such that they

the importance of private business income at the top of the US wealth distribution; tax policies that encourages the long-run retention of income within businesses contribute to private business wealth accumulation.

[13]Gorry et al. (2018) study income shifting by executives and show that accounting for the fact that shifted income is taxed at a future date decreases the estimated welfare loss from personal taxes.

[14]In contrast, S-corporations offer limited scope to shift intertemporally because personal taxes are levied on accrual.

have significant control over the business. We use company level data from company accounts matched to administrative corporate tax records and newly matched to administrative personal tax records of company directors. We study closely held companies that have non-missing information on the number of shareholders and directors and that file 12 month accounts in the years 2005-15. The match between corporate and personal records is available for companies that are active in at least one year between 2013 and 2015. We summarise the data here and provide more details, including on precise variable definitions and samples, in Appendix A.

2.1 Closely held companies

We use data on companies from two sources. We use information on turnover, costs and profits contained in corporate tax records filed at the UK tax authority (HM Revenue & Customs (HMRC)). This information is matched to company accounts data (specifically *Financial Accounting Made Easy (FAME)* provided by Bureau van Dijk), which provides information on company age, the number of directors and shareholders, industrial classification, and assets and liabilities listed on companies' balance sheet. The majority (68%) of UK companies have strictly fewer than three directors and three shareholders; in 90% of these companies, at least one director is also a shareholder (see Appendix A for more details). In what follows we refer to companies with at most two directors and two shareholders as closely held. In some parts of the analysis we consider the subset of closely held companies with one director and one shareholder. This is the configuration that has seen the largest growth, partly a result of a change in UK law that effectively meant that companies were no longer required to have two directors.[15]

Table 2.1 compares the characteristics of closely held companies to those of all UK companies. Closely held companies are slightly younger and are smaller in terms of turnover, profits and assets than all companies. Closely held companies do, however, have higher median profit-to-turnover ratios. Closely held company owner-managers have a strong incentive to take their income, including that part which reflects a return to their

[15]The UK Companies Act 2006 meant that from 6 April 2008 limited companies were no longer required to appoint a company secretary. It is common for company secretaries to be directors.

labour, in the form of returns to capital (i.e. as dividends or capital gains); see Section 3 for more details. As a result, a significant amount of corporate profit will reflect returns to labour of the owner-manager.

For part of our empirical analysis, we study the subset of closely held companies that have only one director and one shareholder. This allows us to more cleanly identify to whom the income generated at the company level flows. These companies are slightly less profitable than the larger closely held companies, but have larger ratios of profit-to-turnover, again reflecting the fact that profit for these companies includes at least some part of the returns to labour of the owner-manager. The incomes of these companies are volatile. Around 40% of the variation in log total income is due to the transitory component of income; this compares to an estimate for all US workers of roughly 10% in Kopczuk et al. (2010) (details of this decomposition are provided in Appendix A.6).

Capital and investment

On average, closely held companies' balance sheets record just under £200,000 in total assets. Current assets, which include liquid financial assets (i.e. cash or cash equivalents), investments and any stock of products yet to be sold, account,on average, for over 75% of total assets.[16] Fixed assets measure a company's stock of "productive capital" and include plant, machinery, fixtures, buildings and intangible assets. The mean closely held company has total recorded fixed assets of £90,000, but the distribution is highly skewed; the median value of fixed assets is around £7,000. We also see evidence of this skewness in the use of capital allowances (tax deductions for investment in components of fixed assets as recorded on corporate tax returns): around 70% of companies use allowances, with a median value of £1700, and a mean of £6300. Any profits that are not paid out in dividends nor invested in fixed assets will appear as current assets. We use the information on fixed assets to investigate whether changes in the marginal rate of personal income tax affect owner-managers' capital investment decisions.

[16]Companies may make investments in other companies (directly or indirectly via indexes). However, there are a number of reasons why a trading company will not want to hold investments that are sufficient to have them classified as an investment company, including the fact that investment companies are excluded from many of the preferential tax treatments given to trading companies.

Table 2.1: *Sample descriptive statistics*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
						Closely held companies							
		All companies				$\leq$ 2 directors, $\leq$ 2 shareholders				1 director, 1 shareholder			
Source	Variable	Mean	Median	P10	P90	Mean	Median	P10	P90	Mean	Median	P10	P90
FAME	Number of directors	2.2	2.0	1.0	4.0	1.6	2.0	1.0	2.0	1.0	1.0	1.0	1.0
FAME	Number of shareholders	2.1	2.0	1.0	3.0	1.4	1.0	1.0	2.0	1.0	1.0	1.0	1.0
FAME	Firm Age (years)	9.9	6.0	1.0	22.0	7.6	5.0	1.0	16.0	4.0	3.0	1.0	9.0
CT600	Turnover (£th)	576.3	106.2	15.5	1,398.4	223.6	82.0	14.4	599.1	123.4	60.7	11.5	303.8
CT600	Profit (£th)	38.5	16.5	-5.0	115.7	30.4	16.8	-2.5	88.8	21.7	11.7	-2.8	66.9
CT600	Profit/Turnover (%)	30.9	22.4	3.6	73.5	33.8	27.3	4.4	74.9	36.5	32.2	4.2	77.3
CT600	Ever use capital allowances (%)	69.9				70.4				58.7			
CT600	Capital allowances (£th)	14.0	2.5	0.2	38.6	6.3	1.7	0.2	18.4	4.3	1.3	0.2	13.2
CT600	Capital allowances/Profit (%)	12.6	2.4	-0.9	52.3	11.3	2.0	-0.0	46.7	10.5	0.9	0.0	45.8
FAME	Total assets (£th)	624,561.0	70.1	7.0	1,669.4	190.4	42.8	5.7	495.8	81.6	23.5	3.5	199.8
FAME	Fixed assets (£th)	225,616.8	14.1	1.0	1,041.5	90.9	7.2	0.7	244.0	33.9	4.0	0.6	84.3
FAME	Current assets (£th)	280,268.3	45.0	4.5	912.1	110.2	30.0	3.7	272.5	51.8	17.9	2.5	131.2
FAME	Current/Total assets (%)	72.9	86.5	18.9	100.0	75.3	88.7	24.7	100.0	78.5	93.2	29.8	100.0
FAME	Shareholder equity (£th)	135,420.0	10.2	-11.0	514.6	55.1	6.0	-8.2	152.8	17.6	2.2	-7.1	59.0
CT600/FAME	Profit/Total assets (%)	75.3	40.5	3.1	217.1	92.3	56.7	7.0	249.1	117.6	78.9	11.0	300.3
	Number of companies	1,578,706				1,093,340				339,504			

Note: Table shows descriptives for three samples. The first sample (columns (3)-(6)) contain all UK companies that operate at some point between 2013 and 2015, have non-missing information on the number of shareholders and directors and file 12 month accounts (see Appendix A for more details). The second sample (columns (7)-(10)) is a subset of the first sample that have $\leq$ two directors and $\leq$ two shareholders. The third sample (columns (11)-(14)) is a subset that have only one director and one shareholder. For each company, we observe the variables listed in column (2) annually in the data source listed in column (1); for a description of the variables see Appendix A. For each company we take the mean of each variable across the period of time they are in the data. The statistics shown in the table are mean, median, 10th and 90th percentiles across companies. Mean calculations (across companies, not when constructing company means) are winsorised at the 1st and 99th percentiles. All monetary values are in 2014-15 prices.

Source: Authors' calculations using accounts data from Financial Accounting Made Easy (FAME) and from administrative corporate tax records (CT600) provided by HMRC.

Industries and business models

There is growing recognition that business owners are a highly heterogeneous group spanning many industries and business models, and not synonymous with entrepreneurs (Humphries (2017)). This is true in the UK, with significant heterogeneity in the activities of closely held companies, including across and within industries. Some company owner-managers are carrying out innovative activity, making (possibly risky) investments and employing others. However, others are effectively just selling their own labour services (IT contractors and locum doctors are common examples of this), and are not making any significant investments.[17]

Consistent with this heterogeneity, there are systematic differences in the activities and returns across industries. Table A.3 in the Appendix lists the top 15 industries among the closely held company population, and describes variation in profits, turnover and assets across industries. Over 1 in 5 closely held companies have the industrial classification "other business activities", which principally includes accountants, (management) consultants, architects, and those in human resources. A further 7% are in the computer services sector (e.g. IT consultants). Companies in these industries have higher ratios of profit to turnover and assets, consistent with the expectation that a significant share of the income of these reflects returns to labour of the owner-manager. There are also substantial numbers of company owner managers operating in construction, retail, health and social work (e.g. doctors), and land transport (e.g. taxi drivers).

2.2 Linking company and owner-manager information

We use a new match between the company data (company accounts and corporate tax returns) and the personal tax records of UK company directors. Without the match, it is possible to observe the income and capital investment decisions of the company and, separately, the incomes (by type) of owner-managers. The match makes it possible to

[17]In some cases, such as when an individual contracts solely and regularly with a single third-party company, owner-managers may in effect be operating as a "disguised" employee. There are laws that seek to prevent genuine employment (i.e. where there is effectively a contract of employment between an individual and a third party) being disguised as a more tax advantaged legal form (IR35 rules). While these rules provide some constraint on who operates through a corporate form, they are imperfect.

link these outcomes and to accurately compute how much income is retained within the company.[18] It is only by combining the data sources that we can study whether the responsiveness of owner-managers' personal taxable income reflects adjustment in the real economic activity by the owner-managers, which will show up at the company level, or different forms of tax avoidance, such as changing the timing of taxable income.

The match between administrative corporate and personal tax records was performed by HMRC (the UK's tax authority). The match is between all company directors that are listed in company accounts in 2013-14 (with a a non-missing date of birth and address) and all self-assessment income tax filers in that year. For matched directors, we have an unbalanced panel of personal and corporate data from 2005-06 to 2014-15.

The data are matched on director name, date of birth and address; more details on this are provided in Appendix A.5. Our matched sample of closely held companies (i.e. that have least one director matched to the personal tax records) is around half our full sample. Of those closely held companies not in the matched sample, 45% were not matched because the director's date of birth or address is missing in company accounts and a further 5% are excluded because they have a director with more than one company directorship. In Appendix A we compare the matched sample with the full sample of closely held companies. The matched companies are of a similar age and have similar turnover, on average, to the full sample of closely held companies. The matched companies do, on average, have higher recorded profit than the full sample; we find that these differences are driven mainly by the fact that companies with zero or negative profits are less likely to be matched. Median asset holdings and the split between current and fixed assets are similar for the matched and full samples, although there are fewer companies in matched sample with very high asset levels, which skews the mean downwards for this sample. Overall, we conclude that our matched sample is broadly representative of those owner-managed companies that do not lie at the very extremes of the profit or asset distribution.

[18]Company accounts data contain a measure of director salaries, but in most cases this variable is missing for our population of interest as it is not a mandatory reporting requirement.

Company owner-managers

Table 2.2 presents summary statistics for directors of closely held companies. These individuals are disproportionately male and have an average age of just under 50. For comparison, UK employees are around 50% male and have an average age of 40 (Cribb et al. (2019)). The age of owner-managers is relevant as it will likely affect their ability and willingness to retain profits until they dissolve their company, or until retirement, when they may choose to draw down the stock of profits through dividend payouts. In Section 4 we show that older owner-managers systematically retain more profits.

Table 2.2: *Summary statistics for closely held company owner-managers*

Variable	Mean	Median	P10	P90
Age (years)	49.1	49.0	35.0	63.0
Share female (%)	28.5			
Wages (£th)	14.4	8.4	1.7	31.0
Dividends (£th)	21.3	17.8	0.0	42.5
Personal taxable income (£th)	39.5	34.1	10.7	75.7
Share in top 1% of income taxpayers	2.5			
Number of owner-managers		689,258		

Notes: The table presents descriptive statistics for the sample of owner-managers (directors) of matched closely held companies. For each owner-manager, we observe variables annually and take the mean of the variable across the period of time they are observed in the data (including the dichotomous indicator variable of whether their income is high enough to be in the top 1% of taxpayers). Appendix A contains details of the sample and variable definitions.
Source: Authors' calculations using HMRC administrative datasets.

The personal taxable income of owner-managers is relatively high – the median is £34,000, compared with a median income of £27,000 for a full-time employee in April 2014.[19] Owner-managers are disproportionately located in the top of the income distribution; 2.5% of them are in the top 1% of UK income taxpayers (which, in recent years, reflect the top 0.6% of UK adults) and 10-15% of the top 1% are owner-managers in any given year. How the tax system treats these individuals, and how they respond to this treatment, is therefore important both for the progressivity of the tax system and post-tax income inequality.

[19]Source: Office for National Statistics, Annual Survey of Hours and Earnings.

Variable construction

We observe company f's post-corporate tax profit, π_{ft}, in year t in the corporate tax returns, and the wage, y_{it}^w and dividend income, y_{it}^d, of the owner-manager i in the personal tax returns. Let $\mathcal{F}_f$ denote the set of owner-managers belonging to company f. We define the total income of company f in year t ($z_{ft} = \pi_{ft} + \sum_{i \in \mathcal{F}_f} y_{it}^w$) as corporate profit minus corporate tax paid, plus any wage income paid to the owner-managers.[20] This is income that flows into the company each year (turnover), after deducting allowable costs (excluding the labour costs of the owner-manager) and corporate tax liability. The total taxable income of owner-manager i in year t ($y_{it} = y_{it}^w + y_{it}^d$) is measured directly from the individual's tax returns as the sum of dividend and wage income.

The flow of retained profits of company f are the difference between the total post-corporate tax income of the company and what is withdrawn as taxable income by the company's owner-managers, $r_{ft} = z_{ft} - \sum_{i=\in \mathcal{F}_f} y_{it}$. For a subset of our empirical analysis we focus on one director one shareholder companies, where $\mathcal{F}_f$ is a singleton for each company. This is because, in the case of one director one shareholder companies, if these individuals were adjusting real activity (i.e the total amount of income they generate at the company level), then the relevant tax threshold is the same as for taxable income.

3 Tax system and incentives

Closely held companies are, like all UK companies, subject to corporation tax at the company level in the year in which profits are earned. Corporate taxable profits are calculated, broadly, as annual revenue (turnover) net of allowable deductions, the most notable of which are employees' costs (including wages, employer social security and pension contributions), interest expenses and capital allowances. From 2006-07 onwards, companies with profit below £300,000 (97% of closely held companies) have faced a flat and stable "small companies" corporation tax rate of between 19% and 21%.[21] Thus,

[20] This is unobserved when there are multiple directors and both are not matched to the personal tax records.

[21] In 2005-06, there was a 0% "starting rate" of corporation tax on the first £10,000 of non-distributed profit. There was a system of "marginal relief" in place that increased the rate from 0% for companies

corporate tax changes did not change the incentives to shift personal taxable income across time, nor to reduce the total amount of income generated by the company.

Our interest is in how the personal income tax system affects company and owner-manager behaviour. When income is distributed to the owner-manager (either as wages, dividends or capital gains) it is subject to personal taxes in the year the income is paid out, not necessarily in the year it flows into the company. The tax treatment of UK company owner-managers means that they can freely choose whether to take their income in the form of returns to labour (wages) or capital (dividends or capital gains) and, by choosing when to take income out of a company, they can choose when to pay personal taxes.[22] The combination of lower rates of tax on capital incomes relative to salaries, and the ability to smooth taxable income over time makes operating as a company owner-manager the most tax advantaged legal form in the UK (Adam et al. (2017)). Further details of the tax system are provided in Appendix B.

In this section, we discuss the incentives that the tax system creates – to shift income intertemporally and to adjust investment and labour supply – and how these inform our empirical approach. We formalise the intuition described in this section using a model of owner-manager choices in Appendix C.

3.1 Personal tax incentives

Taxation of wage and dividend income

While the company is active, an owner-manager can choose to pay themselves either in salary or dividend income. Income paid as salary is deducted from corporate tax, but is subject to both personal income tax and social security contributions (National Insurance Contributions (NICs)). Income paid as dividends is taxed first at the corporate level in

with £10,000 profits to the small companies' rate at £50,000. As such, owner-managers with total incomes close to the higher-rate threshold (i.e. just below £50,000) faced a rate (on retained profits) only slightly below the full small companies' rate.

[22]In the UK there is no equivalent to "reasonable compensation" rules that apply to shareholders of S-corporations in the US and require that the salary portion of the shareholder's remuneration is a reasonable compensation of their labour input. The self-employed (owners of *unincorporated* businesses) are taxed on total income in the year it arises and, as such, have substantially less scope than company owner-managers to shift income intertemporally.

the year income arises, and then attracts personal taxes in the year dividends are paid out. Dividends fall within the personal income tax and are subject to the same thresholds as salary but are taxed at lower income tax rates and do not attract NICs.

The tax minimising way to take income out of the company in all years we study involves taking a salary equal to the point at which personal taxes become payable and withdrawing the remainder as dividend income. This is the most commonly used strategy by owner-managers.[23] In Appendix A.4, we show the composition of taxable income for individuals at different taxable income levels; up to around £10,000, most income is taken as salary, after which point, most income is taken as dividends. Dividend payments are usually less frequent than salary payments, making them less attractive in some cases. However, owner-managers can use "director's loans" to borrow against the income in their company in order to smooth an income stream.[24]

Figures 3.1(a) and (b) plot the marginal tax rate schedules faced by owner-managers assuming that they pay themselves according to the salary/dividend split described above; the marginal tax rate is the combined corporate and personal tax rate on an extra £ earned and taken out of the company. The left hand panel shows the schedule for the 2009-10 tax year. The marginal tax rate increases from 0% to 20% when taxable income exceeds the point at which NICs start to be due (the primary threshold), and from 20% to 40% at the higher rate threshold in income tax – roughly £40,000. This structure is representative of the marginal rate schedules in the tax years before 2009-10, albeit with small changes in the value of thresholds over time. Since the 2010-11 tax year, there have been additional marginal tax rate bands at £100,000 and £150,000, illustrated in the right hand panel.[25]

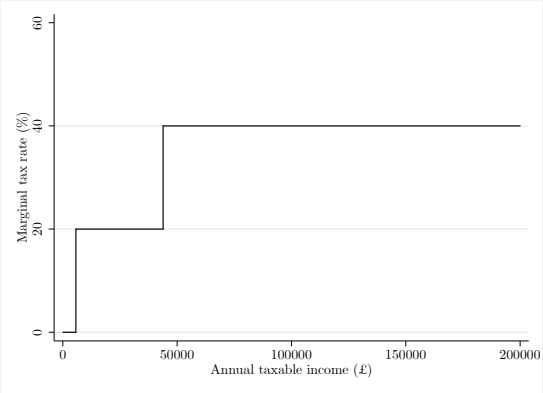
[23]Owner-managers can also reduce their tax liability by making a spouse a shareholder and paying them dividends. These will be included in our sample of companies with at most two directors and two shareholders. We do not, however, observe spousal income.

[24]The tax implications of a director's loan depends on the amount, the interest and when it is paid back. Broadly, for relatively small (£10,000 or less) short term (repaid in full within nine months of the company's accounting year-end) loans no tax is due.

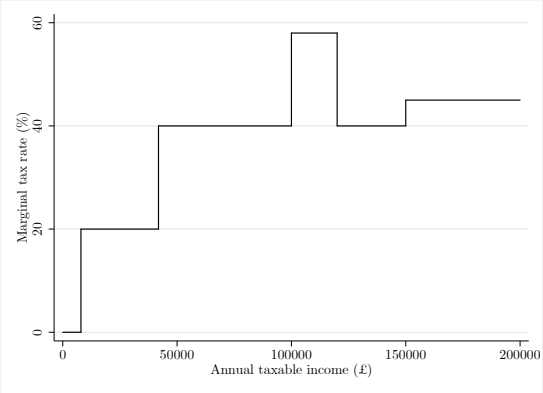
[25]The non-convex nature of the schedule at £100,000 is a result of a policy that withdraws the personal allowance above £100,000: an individual loses 50p of personal allowance for every £1 she earns above £100,000 until the personal allowance has been reduced to zero.

Figure 3.1: *Marginal personal tax rate schedules and taxable income distributions*

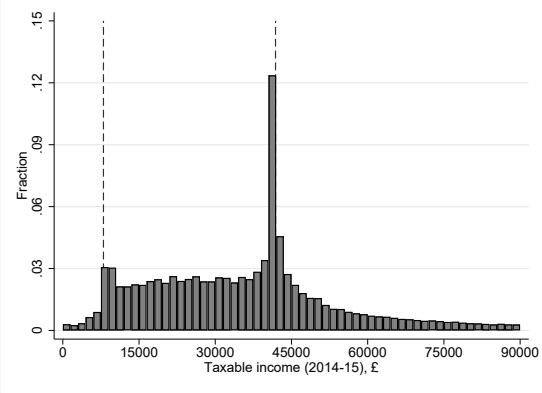
(a) Marginal rates, tax year 2009-10



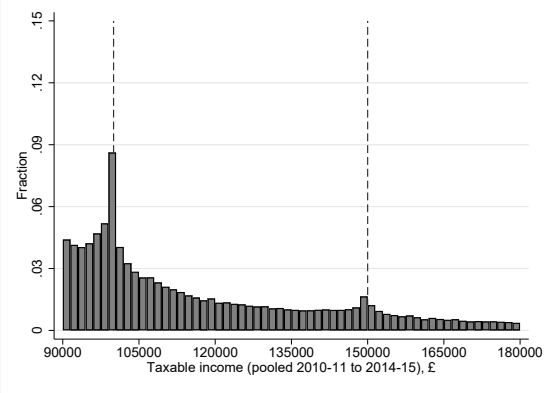
(b) Marginal rates, tax year 2014-15



(c) Income $\leq$ £90,000 (2014-15)



(d) Income > £90,000 (2010-11 to 2014-15)



Notes: Marginal tax rate is the combined corporate and personal tax rate for earning and paying out of the company an extra £1. It assumes an owner-manager follows the strategy of paying him/herself a salary equal to the starting point of NICs (the primary threshold) and paying the remainder in dividends. Thresholds are in nominal terms. In the bottom two panels, black dotted lines indicate increases in marginal rates at the primary threshold (£7,956 in 2014-15), the higher-rate threshold (£41,865 in 2014-15), the beginning of the withdrawal of the personal allowance (£100,000 in each year from 2010-11) and the additional-rate threshold (£150,000 in each year from 2010-11). Bin widths in both panels are £1500.
Source: Various government sources and authors' calculations based on HMRC administrative datasets.

There is clear evidence that owner-managers bunch at the thresholds (kinks) in the personal tax system. Figure 3.1(c) plots the distribution of taxable income up to £90,000 in 2014-15, and panel (d) plots the distribution of taxable income from £90,000 to £180,000 across the period 2010-11 to 2014-15 (the distributions are similar across tax years). There is strong evidence of bunching at the higher rate threshold, as well as at the kink points at £100,000 and £150,000 from 2010-11 onwards. In the Section 4, we disentangle the drivers of this high responsiveness of owner-managers to marginal tax

rate changes. In principle, while the bunching could reflect reductions in labour supply in the face of higher tax rates, it could also reflect intertemporal income shifting.

For owner-managers whose total income fluctuates around a kink, there is an incentive to retain income in the company to smooth this volatility. Consider an owner-manager with average total income below the higher rate threshold. If total income temporarily rises above the threshold, then they can retain this and withdraw in later years (when total income is lower) and avoid paying the higher rate of tax. Owner-managers can simply switch from saving in a personal asset to the company asset, leaving consumption unaffected. Note that this shifting acts to smooth the owner-manager's marginal tax rate across time, and exists *in addition to* the usual consumption smoothing motive in the face of income volatility. As long as individuals have access to personal savings vehicles, they do not need to retain profits to smooth consumption, but will do so only if there is a tax benefit (see Appendix C). If owner-managers are primarily engaging in this form of shifting, then we would expect to see, on average, that they are not systematically retaining income. We would also expect to see them only bunching at the threshold in some years e.g. when their income exceeds the threshold, if, on average, total income is below the threshold.

Taxation of savings and capital gains

When an owner-manager chooses to sell their company or to liquidate the shares on company dissolution, the resulting income is subject to capital gains tax at the personal level. Capital gains are calculated as the difference between the current value of the shares (which is the net value of all assets, including accumulated retained profits) and the value of the shares when the company was started (which is the initial shareholder equity if the whole company is being sold or dissolved).

In general, over the period we study, capital gains are taxed more lightly (heavily) than dividend income above (below) the higher rate threshold. For example, from 2011-12, dividends were taxed at 0% below, and 25% above, the higher rate threshold and owner-managers were eligible for a reduced 10% rate of capital gains tax under "Entrepreneurs'

Relief". As a result, the marginal effective rate (including corporate tax) was 20% for dividend income below, and 40% above, the higher rate threshold and 28% for capital gains.[26] This provides a tax incentive for owner-managers of companies with total income above the higher rate threshold to retain profits in the company and to withdraw it as capital gains upon liquidation.[27]

Shifting income over a long period can lead to substantial tax savings but also comes at a cost to owner-managers if it requires them to delay their consumption. If owner-managers could costlessly borrow against income held in the company, they could adjust taxable income so that they bunch at the higher rate threshold in every period (thereby minimising their tax liability), and then borrow to fund today's consumption above current income. In this case there would be no distortion to the intertemporal allocation of resources. If owner-managers are borrowing constrained, they must effectively choose how much consumption to delay; they will face a kink in their intertemporal budget constraint and the optimal amount owner-managers choose to retain will depend on their marginal rate of substitution between today and the future. The fact that many owner-managers report taxable income above the kink suggests that they cannot costlessly borrow against income held in the company. We would expect agents who are shifting to access lower rates to systemically retain profits and, in some cases, to consistently choose taxable income at the kink.

If an owner-manager is willing to delay taking income until retirement then an alternative, tax advantaged option is pension saving.[28] For an owner-manager who expects to be a basic rate income tax payer in retirement, taking remuneration in the form of pension income attracts the least tax. It does however come at the cost of inflexibility: while earnings retained in a company can be used for investment or withdrawn at any

[26]Effective rates are calculated as (corporate tax rate + (1 − corporate tax rate)$*x$) where x is either the dividend or capital gains tax rate.

[27]As well as realising capital gains on company liquidation, owner-managers with average total income above the higher rate threshold can avoid the higher tax rate by drawing dividends out of a company (up to the higher rate threshold) as it is wound down. The most tax advantaged option is to bequeath capital gains, since the UK tax system forgives capital gains tax at death.

[28]An owner-manager can make employer pension contributions which are free of all tax at the point at which the saving is made (contributions are deductible from corporation tax and exempt from income tax and NICs). Upon withdrawal, 25% of pension savings are tax free and the remainder subject to income tax (and not NICs).

time, pension pots can only be accessed when the individual reaches 55 years of age and, over our period of study, only 25% could be withdrawn as a lump sum with the remainder having to be used to purchase an annuity. There are also annual and lifetime limits (£40,000 and £1,078,900 respectively in 2021-22) on how much can be saved in a pension. We cannot observe pension contributions or savings. However, pension saving is a cost that is deducted when calculating company taxable profits. This means that our measure of total income is net of pension contributions. If we saw total income responding to marginal tax rates (and, as shown in Section 4, we do not), we would not be able to distinguish real responses from changes in pensions saving.

3.2 Investment incentives

The parts of the corporate tax system that determine investment incentives – notably the corporate tax rate and capital allowances – are not a function of personal tax rates and do not change across personal tax thresholds. There is also no incentive for someone to use investment as a way to reduce corporate level (total) income below a personal tax threshold because doing so does not directly affect how much income is taxed at the personal level.[29]

As discussed above, personal taxes do affect incentives to retain income within a company; the opportunity cost of retaining income falls for individuals with annual personal taxable income at or above a personal tax threshold. However, the incentive to use retained profits to invest in productive capital does not depend on the level of personal tax nor change across personal tax thresholds.[30]

[29]Investment may be used to increase consumption if owner-managers purchase assets for personal use but claim them as business assets that attract capital allowances. Anti-avoidance rules seek to prevent such tax evasion but are imperfect. While there is always an incentive to evade taxes in this way, it may be more attractive for owner-managers who choose to bunch at a personal tax kink since it provides a way to extract additional value from the company without increasing tax paid. Brockmeyer (2014) shows that companies increased investment, especially in fast depreciating assets, in response to the £10,000 kink in the corporate tax schedule in the early 2000s.

[30]There is also no change in the incentive to undertake debt financed investments, since the related costs and available deductions are not linked to the personal tax system. Higher personal taxes do reduce the expected return on investment out of new equity; evidence suggests that this source of finance is rare for closely held company owner-mangers.

The effect of personal taxes on marginal corporate investments is central to the "new view" versus "old view" discussion of dividend taxation. The so-called "new view" argues that personal taxes (on dividends) are irrelevant for marginal investments financed from retained equity because they equally affect the opportunity cost of retaining today and the post-tax returns generated tomorrow (Zodrow (1991)). We would expect this line of reasoning to hold for an owner-manager who becomes a higher-rate tax payer today and expects to remain so in future. The irrelevance of dividend tax rates does not hold when returns are expected to be taxed at a lower rate in future (for example as a result of preferential capital gains tax rates). In this case, there is an incentive to generate or realise returns in the future. *If retained income could only be invested in productive capital* (and not held as cash or other investments), we would therefore expect to see increased investment incentives as individuals cross personal tax thresholds. In our setting, we argue that this restriction on portfolio choice does not hold – individuals can realise returns in the future simply by holding cash assets within the company.

Whether a tax-motivated increase in retained profits leads to increased investment in the company's capital stock therefore depends on the portfolio choice of how to hold the retained income within the company – that is, whether to hold the income as cash (or third party investments) or as business capital. This choice will be determined by the relative rates of return on the different asset choices. In Appendix C, we show that when there is a constant return to saving in the company's cash asset then personal tax rates do not affect investment in the company's capital stock. However, if this is not true – e.g because the rate of return varies with the amount invested, or because investment is lumpy – then investment may increase as an *indirect* result of tax-motivated increases in retained profits. We investigate empirically whether there is any evidence of changes to investment decisions as a result of changes in marginal personal tax rates.

4 Results

In this section we present our empirical results. We quantify the importance of income reduction and intertemporal income shifting – the two key ways that company owner-managers can respond to changes in the marginal tax rate faced. We distinguish between intertemporal shifting that can be attributed to a desire to smooth volatility in taxable income around a tax kink versus to take advantage of lower rates in some future period. Having shown that income shifting accounts for all of observed responses and that a large part of this response is the result of the systematic retention of profits, we investigate whether there is evidence that tax motivated increases in retained profits lead to higher investment.

4.1 Income reduction versus intertemporal shifting

We use two different methods with different samples of owner-managers to investigate how owner-managers respond to changes in their marginal tax rates. First, we analyze bunching behaviour around the higher rate income tax threshold – an increase in the marginal tax rate of 20 percentage points at approximately £40,000. Second, we study the effect of two policy changes in 2010-11 that increased the marginal tax rate for individuals earning above £100,000.

Bunching at the higher rate threshold

Figure 3.1 shows that there is large bunching in annual (personal) taxable income around the higher rate threshold. This will capture the combined effect of all responses to the increase in the marginal rate at the kink. To disentangle the different ways that owner-managers may respond to the higher marginal rates we compare the bunching mass in annual taxable income to the bunching mass in total income (we use both an annual and an average measure). Responses in total income will reflect changes in labour supply as well as capturing evasion (for example in how much total income is declared) and pension

savings (as discussed in Section 3.1), but will not include changes due to intertemporal income shifting.

To estimate the excess mass in income due to bunching we follow Chetty et al. (2011) by using a flexible polynomial fitted to the observed distribution of income as an estimate of the counterfactual income distribution in the absence of the kink. For each income measure, x, we exclude observations in a window, $[x_-, x_+]$, around the threshold x^* and account for the fact that owner-managers who bunch come from above the kink point by imposing the integration constraint that the area under the counterfactual distribution of income must equal the area under the empirical distribution.[31]

The key identifying assumptions are: (i) that the only thing that changes across the kink is the marginal tax rate (i.e. all other owner-manager characteristics are smoothly distributed) and (ii) our parametrization of the counterfactual distribution (Blomquist and Newey (2017)). In Appendix D.2, we show robustness of our results to the degree of polynomial, p, and the excluded region around the kink, $[x_-, x_+]$.

We use the sample of one director, one shareholder companies who are observed in the data for at least three years. This is so total income reflects the total output of the owner-manager and the personal tax threshold is relevant for total and taxable income; if there were two owners who reduced effort to bunch at the personal tax kink, this would translate to total income of twice the kink. Restricting the sample to owner-managers present in multiple years ensures we can calculate an average total income.[32] Figure 4.1(a) shows the distribution of annual taxable income (centered at zero around the kink), pooling observations across the tax years 2005-6 to 2014-15. There is a large

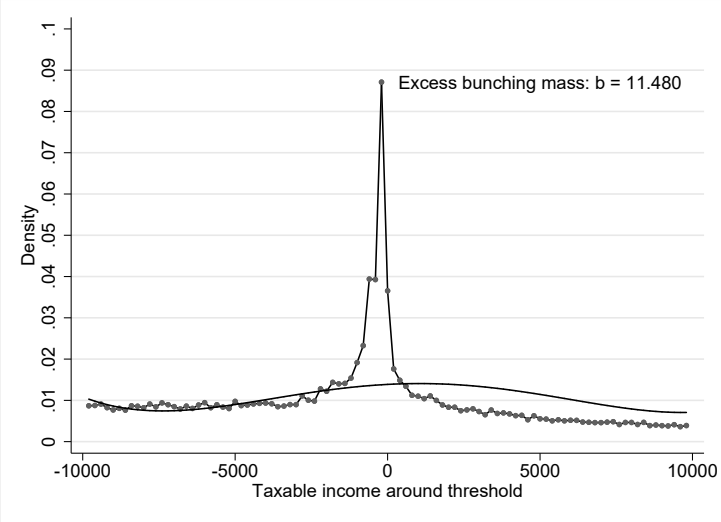
[31] We group owner-managers into income bins indexed by j; c_j is the number of owner-managers in bin j, x_j is the income level in bin j, $[x_-, x_+]$ is the excluded range and p is the order of the polynomial. We use an iterative procedure to estimate the counterfactual distribution, $\hat{c}_j = \sum_{i=0}^{p} \hat{\beta}_i (z_j)^i$ as the fitted values from: $c_j \cdot \left(1 + \mathbf{1} \cdot [j \geq x_+] \frac{\hat{B}_N}{\sum_{j=x_+}^{\infty} c_j}\right) = \sum_{i=0}^{p} \beta_i \cdot (z_j)^i + \sum_{i=x_-}^{x_+} \gamma_i \cdot \mathbf{1}[z_j = i] + \nu_j$ where $\hat{B}_N = \sum_{i=x_-}^{x_+} \hat{\gamma}_i$ and we define $\hat{b}_x$ as the excess mass around the kink relative to the average density of the counterfactual income distribution between x_- and x_+: $\hat{b}_x = \frac{\hat{B}_N}{\sum_{i=x_-}^{x_+} \hat{c}_j / (x_+ - x_-)}$

[32] We show that the distribution of taxable income for all one director, one shareholder companies is very similar to both the distribution for those present for at least three years (see Appendix D) and to the distribution for all closely held company directors (see Appendix A).

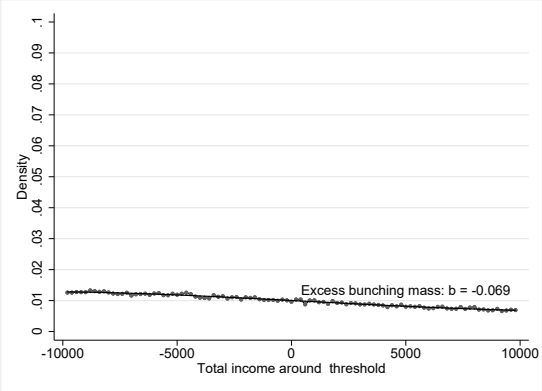
excess mass at the kink, reflecting the high degree of responsiveness of owner-managers' taxable income to changes in the marginal rate.

Figure 4.1: *Bunching around the higher rate threshold*

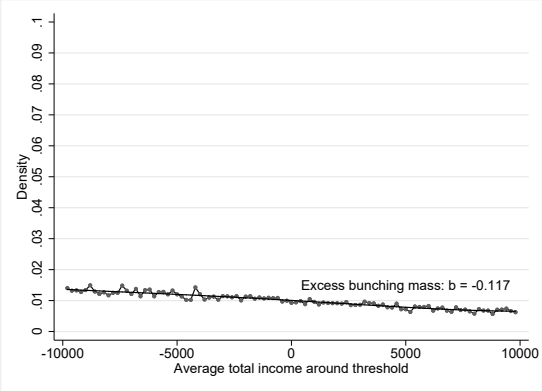
(a) Annual taxable income



(b) Annual total



(c) Average total



Notes: The top panel shows the distribution of annual taxable income, the bottom left panel the distribution of annual total income and the bottom right panel the distribution of average total income. Method for estimating the counterfactual density described in the text. Bin width is £200. The distribution is drawn for the sample of owner-managers of one director one shareholder companies who are present in the data for at least 3 years. Details on sample definition are provided in Appendix D.1 and robustness to order of polynomial and excluded region in Appendix D.2.
Source: Calculations based on HMRC administrative datasets.

Figure 4.1(b) shows the distribution of annual *total* income. There is no evidence of bunching in this income measure i.e. owner-managers are not adjusting total income to locate at the kink point. However, given that total income is subject to volatility, and owner-managers can easily shift personal income from year to year, we may not expect to see bunching in this measure, even if income is being reduced because of the kink (le

Maire and Schjerning (2013)). Figure 4.1(c) plots the distribution of *average* total income around the threshold.[33] If owner-managers were, on average, reducing their work effort, and hence total income generated, in response to the tax increase at the kink, we would expect to see some, at least diffuse, bunching in this measure. There is no evidence of any bunching in average total income.

The tax records do not allow us to distinguish between dividends received from an owner-manager's company and any third party dividends they may receive. Although this does not affect our analysis of bunching in taxable income, a potential concern is that it could affect our analysis of bunching in total income (since the effective kink that the owner-managers face is now shifted by the amount of third party dividends that they receive). However, we think that this is unlikely to overturn our results for three reasons. First, our measure of retained profits (i.e. company profit minus income paid out to owner-managers) lines up well with an alternative measure that we construct using shareholder equity from company accounts. This would not be the case if large amounts of dividend income were, in fact, from third parties, as opposed to the individual's own company. Second, only 15% of taxpayers who are not directors of closely held companies receive dividend income; although company directors will be different, it seems reasonable to expect the majority of them to also have no other dividend income.[34] In the absence of significant third-party dividend income, the higher rate threshold is still the relevant threshold for bunching in the majority of cases. In addition, our difference-in-differences approach does not require that we separate out any third party dividends from those of the company, and we still find no effect of personal taxes on the profit of treated closely held companies (described fully below).

The difference between total and taxable income is driven by the retention of income within the company. The absence of any discernible response in average total income

[33]We take a 3 year average for each agent; we get the same results if we take averages over 2, 3, 4 or 5 years.

[34]The 15% statistic is calculated using data from the Survey of Personal Incomes (which is also based on HMRC tax records and covers a representative sample of UK taxpayers). 15% refers to taxpayers with income between £20,000 and £60,000, and are therefore more comparable to the owner-managers who are likely to bunch at the higher rate threshold.

to the kink at the higher rate threshold indicates that the main margin of response is intertemporal shifting.

Separating the motivations for intertemporal shifting

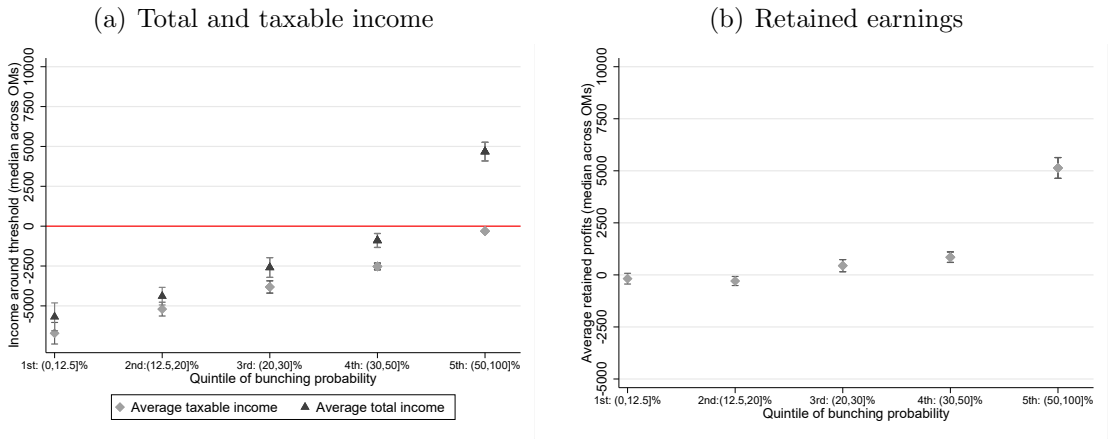
In Section 3, we argue that there are two main reasons why owner-managers may shift taxable income across time in response to changes in their marginal tax rate. First, to smooth out volatility in their total incomes, which allows them to avoid being penalised by the progressivity of the tax system if their total income fluctuates around the kink. Second, some owner-managers may systematically retain profits in their company in order to take advantage of lower tax rates in the future. To understand the relative importance of these two motivations, we consider persistence in bunching and retention behaviour.

We expect owner-managers who shift to smooth income volatility to: (i) only bunch at the threshold intermittently e.g. when their total income temporarily goes above the threshold; (ii) to not systematically retain income i.e. on average their total incomes equal their taxable incomes. For the set of owner-managers that bunch at least once during their time in the sample we calculate the fraction of years that we observe them bunching ("bunching probability"), and use this to proxy whether they are bunching to smooth volatility or to systematically retain income and access lower future rates. We group owner-managers into quintiles on the basis of their bunching probability.

Figure 4.2(a) shows that owner-managers who bunch in fewer than 50% of the years in which we observe them – and that we will refer to as "sometimes bunchers" – have bunching behaviour that is consistent with smoothing out volatility in total income. Their average total income is below the higher rate threshold and very close to their average taxable income. We also find that those with average total income below the threshold are much more likely to bunch when their income is higher than usual (i.e. when there are benefits to retaining), compared with when their income is lower than usual. Similarly, those with average total income above the threshold are more likely to bunch when their income is lower than usual (i.e. when there are benefits to withdrawing).

In contrast, owner-managers who bunch in 50% or more of years - and that we will refer to as "consistent bunchers" – have average total incomes significantly above average taxable incomes and, as a result are systematically retaining profits (Figure 4.2(b)). Retention is substantially higher, on average, for those bunching consistently. We also note that there is no difference in total income volatility across the fraction of years spent bunching – it is not the case, for example, that those that bunch more have more volatile incomes.

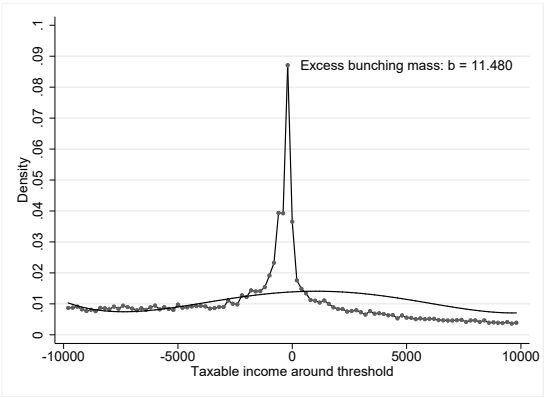
Figure 4.2: *Total income, taxable income, and retained profits conditional on frequency of bunching*



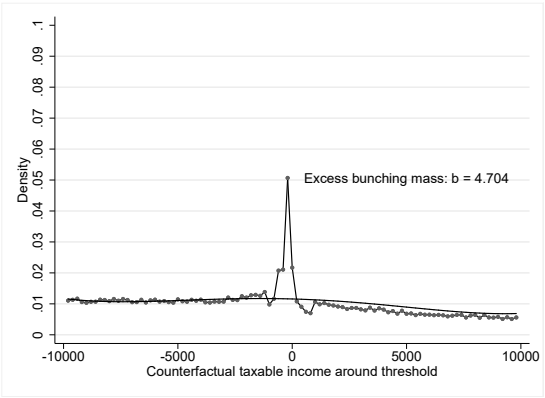
Notes: We use the sample of single director single shareholder companies that we observe in the data for at least three years. For each owner-manager, we calculate the fraction of years they bunch at the higher rate threshold in annual taxable income. We place owner-managers into one of five quintiles based on this fraction, shown on the horizontal axis in each panel. For each owner-manager, we take their average taxable and average total income (centered around the higher rate threshold) and average retained profits across years that we observe them. The left hand panel shows the median of average taxable and average total income, and the right hand panel shows the median of average retained profits, across owner-managers within each fraction group.
Source: Calculations based on HMRC administrative datasets.

Figure 4.3: *How much is bunching at the higher rate threshold explained by the different motivations for shifting?*

(a) Sometimes and consistent bunchers



(b) Consistent bunchers only



Notes: Method for estimating the counterfactual density described in the text. Bin width is £200. The left hand panel shows the observed distribution for one director one shareholder owner-managers who are present in the data for at least 3 years (this repeats Figure 4.1(a) above). The right hand panel shows the distribution when we replace the annual taxable income of the "sometimes bunchers" (owner-managers who bunch less than or equal to half the number of years they are observed) with their annual total income in that year.
Source: Calculations based on HMRC administrative datasets.

To quantify the extent to which shifting to smooth income volatility explains the observed responsiveness in annual taxable income at the higher rate threshold, we construct a distribution of annual taxable income that seeks to remove the effect of shifting to smooth volatility. Specifically, we consider bunching in annual taxable income after replacing annual taxable income for "sometimes bunchers" with their annual total income. This essentially constructs a measure of the hypothetical distribution when those that shift to smooth volatility are restricted from doings so (and instead receive their annual total income). Figure 4.3(b) shows that "sometimes bunchers" make up around half of the excess mass in the annual taxable income distribution around the higher rate threshold.

We conclude that around half of the observed responsiveness of owner-managers' taxable income to the kink at the higher rate threshold can be attributed to intertemporal shifting that allows volatility in total income to be smoothed. The benefits of "tax smoothing" have been widely discussed, particularly in the context of savings taxation (Mirrlees et al. (2011)), and date back to Meade (1978) and Bradford (1982). Although large avoidance elasticities often reflect poorly designed tax systems (Piketty

et al. (2014)), in this case allowing individuals with volatile incomes to smooth out fluctuations means that they are not penalized by the progressivity of the tax system relative to someone with the same average, but stable income. Effectively, smoothing allows the tax system to better approximate the taxation of lifetime incomes. There nonetheless remains a considerable excess mass due to owner-managers consistently bunching and retaining profits, which we describe further in Section 4.2.

Tax rate increases on taxable incomes above £100,000

We use an alternative method and sample of owner-managers to provide additional evidence on the responsiveness of owner-managers to personal tax rate changes. We use two policies that were announced in March 2009 and introduced in April 2010 and that resulted in individuals with incomes above £100,000 having their tax-free allowance withdrawn (at a rate of 50p for every £1, earned above £100,000) and individuals with taxable income above £150,000 facing a new higher 50% (subsequently reduced to 45% in 2013-14) marginal rate. We exploit the variation in personal tax rates that these reforms created across time using a differences-in-differences estimator.

This approach does not require us to restrict our sample to only one director, one shareholder companies. We use the sample of closely held companies that have at most 2 directors and 2 shareholders and have at least one of the directors matched to the personal income tax records. This gives us more power, which is important as there are fewer owner-managers in this part of the income distribution. In this sample we cannot construct the total income measure, z_{ft}, for all companies because the match to the personal tax records of the owner-managers is incomplete. Instead, we look at whether there are changes in post-corporate tax corporate profit (which will capture dividends and any retained profit, but not any wages paid to directors); the incentives to pay dividends rather than wages did not change over this period at any income level. We use the year-

on-year change in shareholders' equity to proxy retained profits,[35] and study whether this increased for those subject to higher personal tax rates.

Let i index owner-managers and f indexes companies. We define a treated group of owner-managers as those whose taxable income was always between £95,000 and £200,000 in the tax years 2005-6 to 2008-9; let $D_i = 1\big(y_{it} \in [95000,\ 200000]\ \forall t \leq 2009\big)$ denote the treatment dummy for owner-manager i. The control group of owner-managers is defined analogously as those whose taxable income was always between £50,000 and £95,000 in the pre-period: $C_i = 1\big(y_{it} \in [50000, 95000)\ \forall t \leq 2009\big)$. The treated group of companies is defined as the companies where all observed owner-managers are treated, $D_f = \min_{i \in \mathcal{F}_f} D_i$, and the control group of companies are those with at least one control owner-manager and no treated owner-manager, $C_f = \max_{i \in \mathcal{F}_f} C_i \times \min_{i \in \mathcal{F}_f}(1 - D_i)$. We show robustness to the treatment and control income cut-offs in Appendix D.3. In our baseline scenario, we estimate on an unbalanced panel, but we also show robustness to estimation on a balanced panel in Appendix D.3.

We estimate the following three regressions:

$$\ln(y_{it}) = \sum_{s \neq 2009} \beta_s^{\text{taxable}} D_i \times 1[\text{year}_t = s] + \varphi_t + \alpha_i + \nu_{it} \tag{4.1}$$

$$\ln(\pi_{ft}) = \sum_{s \neq 2009} \beta_s^{\text{profit}} D_f \times 1[\text{year}_t = s] + \varphi_t + \alpha_f + \nu_{ft} \tag{4.2}$$

$$A_{ft} - A_{ft-1} = \sum_{s \neq 2009} \beta_s^{\text{equity}} D_f \times 1[\text{year}_t = s] + \varphi_t + \alpha_f + \nu_{ft} \tag{4.3}$$

for (in the case of (4.1)) the sample of owner-managers in either the treatment or control groups ($\max\{D_i, C_i\} = 1$) and (in the case of (4.2) and (4.3)) for the sample of companies in either the treatment or control groups ($\max\{D_f, C_f\} = 1$). y_{it} is director taxable income; π_{ft} is company post-corporate tax profit, and $A_{ft} - A_{ft-1}$ is the change in shareholder's equity. φ_t denote common year effects, α_i and α_f denote owner-manager and company fixed effects, respectively, and ν_{it} and ν_{ft} are unobserved error terms.

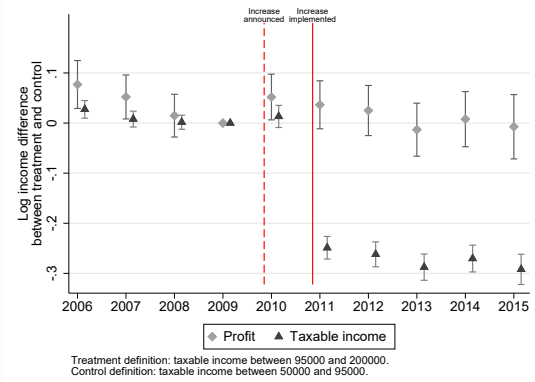
[35] Shareholders' equity is the difference between total assets (including any equity retained in the company), and total liabilities (i.e. it measures the net value of the company). Additional retained profits (conditional on a level of liabilities) will appear as a one-for-one change in shareholder equity.

The key identifying assumption is the usual parallel trends assumption i.e. in the absence of the reform, the incomes and profits of the treatment and control groups would have evolved similarly. We have four years in the pre-reform period, which allows us to check whether the pre-trends across the treatment and control groups look similar.

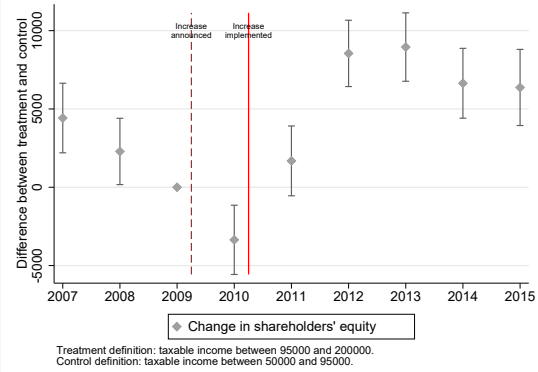
Figure 4.4(a) shows the estimated coefficients from equations (4.1) and (4.2); these are relative to 2009, the omitted year. Taxable income evolves similarly for the treatment and control group in the pre-reform period; for profit, there is some evidence of a decline in the treatment relative to the control group in the pre-reform period, but these differences are not significantly different from zero. We see no statistically significant reduction in the corporate profit of companies with treated owner-managers compared with the control group following the introduction of higher marginal rates on high incomes after 2010. That is, the amount of underlying economic activity among the treated companies does not change in response to the reform. However, the figure shows a clear fall in taxable income for treated owner-managers. This effect persists over the following four years.

Figure 4.4: *Coefficients from differences-in-differences regressions*

(a) Taxable income and profit



(b) Shareholder's equity



Notes: Left hand panel: black markers show the estimated $\beta_s^{taxable}$ coefficients from equation (4.1); grey markers show the estimated β_s^{profit} coefficients from equation (4.2). Right hand panel: the grey markers show the estimated β^{equity} coefficients from equation (4.3). In both cases the omitted year is 2009. Error bars show 95% confidence intervals. Years on the horizontal axis refer the calendar year in which the tax year ends i.e. 2007 refers to the tax year April 2006 to April 2007. Table of coefficients is available in Appendix D.3.
Source: Calculations based on HMRC administrative datasets.

These results indicate that owner-managers responded to the reforms by retaining income within their companies and is therefore consistent with the bunching evidence

that the high responsiveness of company owner-managers to marginal tax rate changes is entirely explained by intertemporal income shifting. Figure 4.4(b) shows this directly. The year-on-year change in shareholders' equity was higher for the treatment group relative to the control group in the post-reform period. That is, following the reforms (which increased the difference between current and future tax rates), owner managers persistently retained more income within their company. The estimated negative coefficient in 2010 is consistent with bringing forward dividend payments, and thus reducing shareholder equity, in anticipating of the reform. This is a form of short run shifting of taxable income in order to avoid a higher marginal tax rate.

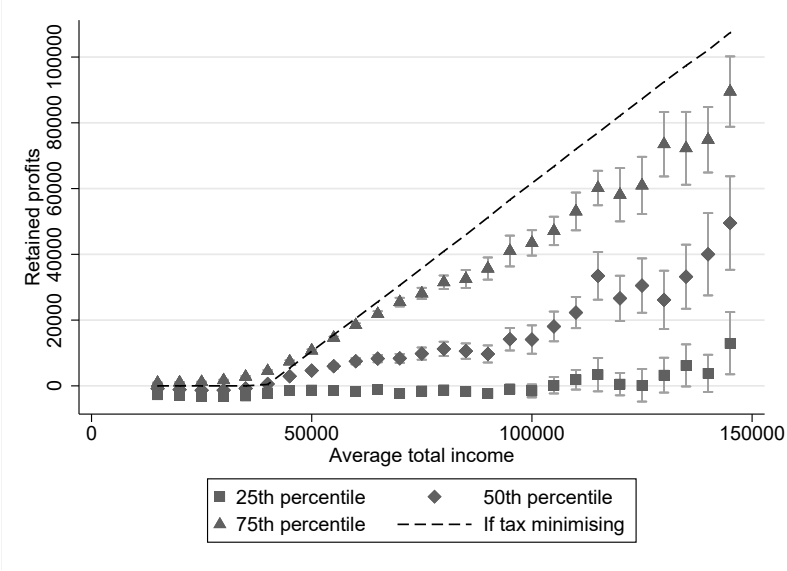
4.2 Who retains profits and how do they invest them?

The results above show that the retention of profits is the main response of owner-managers to changes in marginal tax rates. The incentive to shift to smooth volatility is only relevant for those owner-managers whose total income fluctuates around a threshold. Among single director single shareholder companies, we find that 16% of owner-managers are "sometimes bunchers" around the higher rate threshold (i.e. engage in bunching to smooth income volatility). A further 6% of owner-managers consistently bunch at the higher rate threshold and retain all income above this; this is the tax-minimizing strategy that we would expect everyone to follow if there were no costs to shifting.

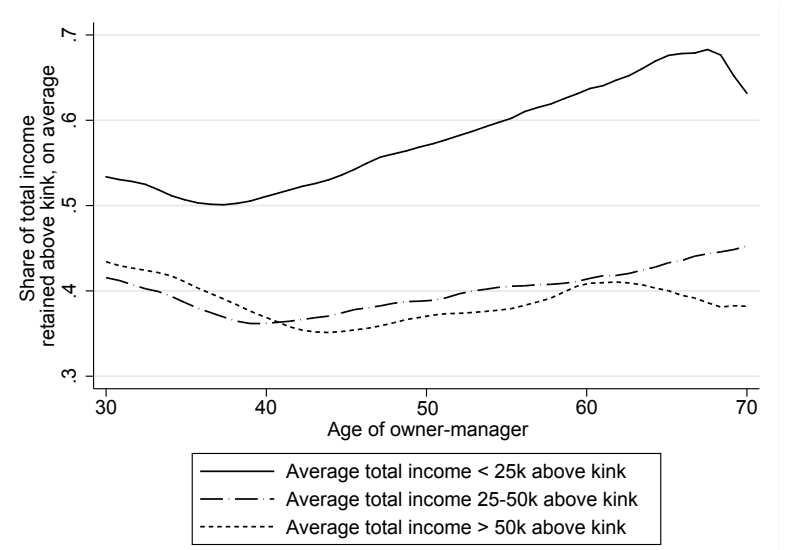
However, the incentive to retain to shift income to the future exists for all owner-managers whose average total income exceeds the higher rate threshold: many more owner-managers with average total incomes above the threshold retain substantial amounts, even if they are not "fully retaining". Figure 4.5(a) shows that there is little systematic retention of profits by those with incomes below the higher rate threshold. Above the threshold (approximately £40,000) the amounts retained are large and increasing: for those earning more than £150,000, half retain in excess of £50,000 each year and 25% retain more than £90,000.

Figure 4.5: *Retained profits across the total income distribution and by age*

(a) By total income



(b) By age



Notes: For each single shareholder single director company owner-manager we construct their average total income, average retained profits and the share of total income above the higher rate threshold that each owner-manager retains, on average. The top panel shows the 25th, 50th, and 75th percentiles of average retained profits conditional on binned average total income, across owner-managers. Error bars show 95% confidence intervals. The bottom panel shows the conditional mean of the share of total income above the higher rate threshold that is retained, at ages of the owner-manager, by banded average total income.
Source: Calculations based on HMRC administrative datasets.

We would expect retention to be highest for those individuals that face the fewest constraints (lowest costs) on their ability to retain and smooth consumption. Individuals may have relatively low costs associated with their retention because: (i) there is a

relatively short period between today and when they expect to access a lower rate of tax (for example they are closer to retirement or liquidating their company); (ii) they have built up personal assets that they can draw down to offset the asset accumulation in the company, thus minimising the distortion to intertemporal consumption. Both of these factors are more likely to be true for older individuals. Figure 4.5(b) shows that retained profits increase as owner-managers approach retirement age, particularly for those with total incomes less than £25,000 above the higher rate threshold.

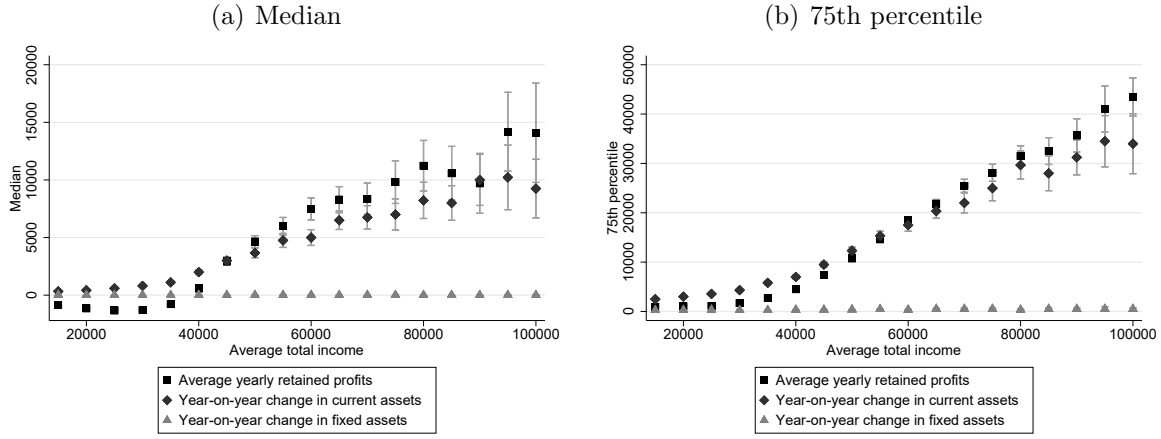
Impact on capital investment

Policy makers often support lower capital gains tax rates (relative to taxes on salaries or dividends) as a mechanism to encourage business owners to invest in their own enterprises. Preferential capital gains tax rates incentivise owner-managers to retain profits in their companies and we see clear evidence of this. But, as argued in Section 3, tax measures that incentivise profit retention do not directly change the incentives to invest in the capital stock of the company rather than hold retained profits in cash (or equivalents) or as investments in third parties. Additional tax-motivated retained profits would only be expected to lead to higher investment if the rate of return on investment relative to a cash asset is increasing in the size of retained profits.

We find that tax-induced increases in retained profits are held in cash (or equivalent financial assets) and do not change companies' capital stock. We show this in two ways.

First, we construct, for each owner-manager, the average year-on-year change in current and fixed assets. Figure 4.6 shows the 50th and 75th percentile of asset changes and average yearly retained profits, conditional on average total income. At all income levels, the increase in retained profits above the higher rate threshold is matched by an increase in current assets, but not fixed assets. This suggests that retained profits are held as cash, or cash equivalents, and not invested in the company's productive capital.

Figure 4.6: *Retained profits and asset growth*



Notes: For each single shareholder single director company owner-manager we construct their average total income, average yearly retained profits, and average year-on-year change in current and fixed assets. The left hand panel shows the median and the right hand panel shows the 75th percentile across owner-managers.
Source: Calculations based on HMRC administrative datasets.

This analysis of average asset growth may not capture the fact that investment choices are lumpy, or respond to lagged increases in retained profits. Our second approach therefore uses a differences-in-differences approach, as described in Section 4.1, to analyze the impact of the policy reforms that increased tax rates on higher income individuals in 2010-11 on subsequent investment in fixed assets. To allow for the lumpy nature of investment, we construct a dummy, $\tilde{i}_t$, equal to 1 if there was an increase in fixed assets greater than or equal to 20% of the stock of fixed assets.[36] That is, we consider whether tax induced increases in retained profits make it more likely that a company will subsequently undertake a significant investment. We estimate:

$$\tilde{i}_t = \sum_{s \neq 2009} \beta_s^i D_f \times 1[\text{year}_t = s] + \varphi_t + \alpha_f + \nu_{ft} \tag{4.4}$$

where the sample and variable definitions are the same as those used in Section 4.1.

Figure 4.7(a) shows that there is no difference in the capital investment of the treatment compared with the control group following the reform for the full sample of compa-

[36]It is well documented that non-convex capital adjustment costs (such as fixed costs) and indivisibility of investment projects lead to firm-level investment profiles characterised by periods of low or zero investment, punctuated by large discrete changes, commonly referred to as "spikes" or "lumps" (Doms and Dunne (1998), Cooper and Haltiwanger (1993), Caballero (1999), Cooper et al. (1999), Nilsen and Schiantarelli (2003), Cooper and Haltiwanger (2006)). Disney et al. (2019) use the same UK data, measure an investment "spike" as a change in fixed assets of at least 20% and discuss this choice.

nies. Figure 4.7(b) shows that for a sub-sample of "high fixed asset companies", which are defined as those with an average fixed asset holding of above £100,000 over our sample period, the year immediately preceding the reform, 2009, had lower levels of investment than either the pre- (2007-8) or post- (2011-15) period, likely capturing depressed investment during the Great Recession. This is consistent with evidence that the large fall in UK investment following the financial crisis happened in 2009 and was driven by large firms reducing the number of investment projects they undertook (Disney et al. (2019)). The fact that we see little to no change in investment, alongside an increase in shareholders' equity (Figure 4.4(b)), suggests that the additional retained profits are held as cash rather than invested in productive capital.

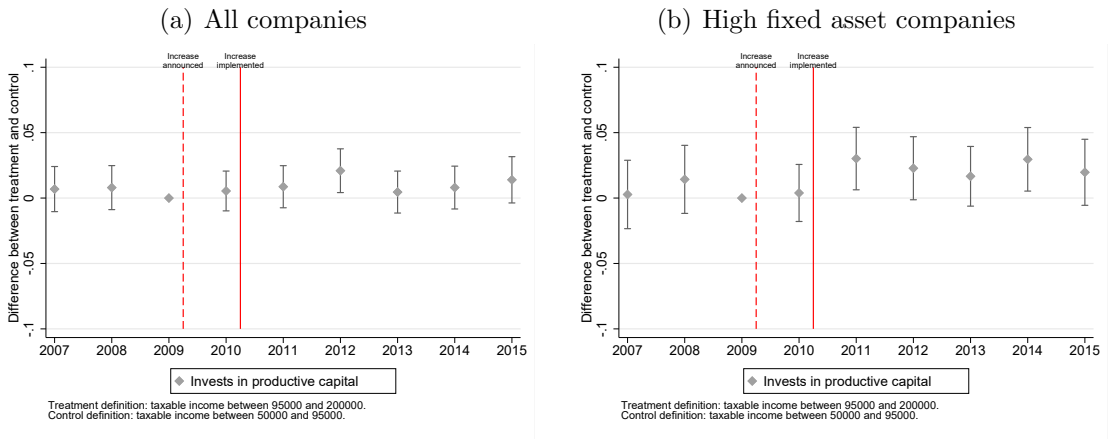
By retaining income in a company (even when it is not used for investment), owner-managers can realise significant tax savings. Most notably, most owner-managers will be eligible for "Entrepreneurs' Relief" - a preferential 10% rate of capital gains tax available to business owners. For a subset of owner-managers we can quantify the tax benefit associated with this relief.

In 2014 and 2015, there were 7,707 owner-managers of closely held companies (both one and two director) who ceased being a director (we cannot observe those who ceased being a director in earlier years in available tax records). Of these directors, 20% claimed Entrepreneurs' Relief in 2016.[37] This rises to almost half for those with shareholders' equity that exceeds £100,000 during our sample period. There is a strong positive, close to one-for-one, relationship between the level of eligible capital gains on which relief was claimed and the value of shareholders' equity in the preceding year. That is, on average, owner-managers take gains equal to the total value of shareholders' equity in the year before they cease being a director: all of their accumulated retained profits are being subjected to the lower rate. The amounts of income taxed under Entrepreneurs' Relief are large: the average eligible capital gains, conditional on claiming the relief, is around £500,000 *per owner-manager*. This can produce substantial tax savings. For example,

[37]Those not observed claiming Entrepreneurs' Relief in 2016 may do so in later years, outside of the scope of currently available data.

total tax due is £75,000 lower if £500,000 is subject to a 10% rate of Entrepreneurs' Relief than if the same amount had been taxed at 25% (the higher rate of dividend tax).

Figure 4.7: *Coefficient estimates from differences-in-differences specification, investment*



Notes: The markers show the estimated β_s^i coefficients from equation (4.4); the omitted year is 2009. The dependent variable is a dummy equal to 1 if there is an increased in fixed assets greater than 20% of the fixed assets stock. Error bars show 95% confidence intervals. Years on the horizontal axis refer the calendar year in which the tax year ends i.e. 2007 refers to the tax year that runs from April 2006 to April 2007. The left hand panel shows the estimates for all companies, and the right hand panel shows the estimates for "high fixed asset companies", which are defined to be those with an average fixed asset holding of above £100,000 over our sample period.
Source: Calculations based on HMRC administrative datasets.

For some company owner-managers, retained earnings will represent retirement savings. Such savings may be higher as a result of the preferential capital gains tax rate. For example, some owner-managers will prefer saving within their company, even if the tax savings are lower than for regular pension saving, because it comes with significant additional flexibility. As such, from a policy perspective, there may be some beneficial effects from the preferential capital gains tax rate i.e. to the extent that the policy boosts savings in cases where government thinks that its desirable. However, this must be weighed against the costs of the policy. These include the revenue loss on retained earnings that not are retirement savings, or that are above the limits that the government sets for regular pensions saving. It also creates horizontal inequity because most people are not company owner-managers and therefore cannot access this tax-preferred and flexible form of savings.

5 Summary and discussion

We use a new link between personal and corporate UK administrative tax returns to investigate how personal taxes affect the behaviour of company owner-managers. Previous work has shown that owner-managers are very responsive to taxes and this is often driven by avoidance behaviour. By accurately measuring both the total amount of economic activity produced by a business owner and the amount of personal income withdrawn from a company each year, we are able to show that the entire response of owner-managers' taxable income to higher rates of personal tax is driven by intertemporal income shifting.

We show that around half of this shifting is to smooth volatile incomes around a tax kink. As well as implicitly allowing smoothing through the use of company structures, the UK operates explicit regimes that allow farmers and some artists and authors (groups which are known to have particularly volatile incomes) to smooth their tax liabilities over tax years. However, this option does not extend to those running unincorporated businesses, who also have volatile incomes. There is a case for governments extending the ability to smooth taxable income to more individuals so that a progressive income tax system does not penalise income volatility.[38]

However, we also find that there is substantial profit retention among owner-managers, motivated by the UK's preferential rate of capital gains tax. Policy makers often perceive a trade-off between, on the one hand, using lower taxes on capital income, particularly capital gains, as a way to boost investment incentives and, on the other hand, raising capital tax rates towards personal income tax rates to minimise tax avoidance, avoid distorting choices and limit post-tax inequality.

Reduced tax rates on capital incomes are not well targeted at removing distortions to investment that are created by the design of the tax base (Mirrlees et al. (2011)) nor at dealing with any market failures associated with entrepreneurship (Gordon and Sarada (2018))).[39] We find no evidence that the preferential rate of capital gains tax distorts

[38]Denmark provides one example of how this can be done. There is an explicit savings vehicle to allow the self-employed to smooth total income across tax years (le Maire and Schjerning (2013)).

[39]In the UK - as in most places - capital taxes are levied on the normal return as well as any excess returns. The former creates a range of distortions, including deterring marginal investments. These distortions can be removed through careful design of the tax base, see Mirrlees et al. (2011).

investment decisions of company owner-managers. Conditional on company formation, the policy is not correcting any market failures that may exist, but nor it is leading investment capital to be sub-optimally allocated towards investment in the capital stocks of closely held companies. It does, however, raise important equity concerns. Company owner-managers are over-represented at the top of the UK's income distribution and, within the closely-held company population, income retention (and therefore access to lower taxes) is skewed towards those with higher average total incomes.

All of the results in this paper are conditional on the institutional setting. We argue that the key institutional features – notably the tax advantage associated with the corporate legal form, the significant freedom to decide when income is taxed at the personal level and the preferential rate of capital gains tax for businesses assets – are common across, and therefore of interest in, many tax systems. However, the results cannot be used to conclude that the real activities of owner-managers (which we find are not responsive to higher tax rates) would remain unaffected by personal taxes if the ability to shift income, or the associated tax advantages, were removed. Those working for their own business usually have significant flexibility over their labour supply, making it highly plausible that, absent the ability to shift intertemporally or engage in other forms of avoidance and evasion, their underlying labour supply would be more responsive to taxes than that of employees.

Understanding how company owner-managers respond to various features of the tax system has become more important as the number of people working through their own businesses has grown. Equally important, given this labour market trend, is understanding how various features of the tax system – including the interaction between corporate and personal taxes and the treatment of volatile incomes and losses – affect who starts a business and their choice of legal form, which we plan to explore in future work.

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Appendix

For Online Publication

Intertemporal Income Shifting and the Taxation of Business Owner-Managers

Helen Miller, Thomas Pope and Kate Smith

A Data

This paper uses administrative data from corporate and personal tax records provided by HMRC (the UK tax authority), supplemented by data from company accounts. This section describes the data, including the construction of samples, and provides additional descriptive results.

A.1 Closely-held companies

Company population

The primary dataset on companies is drawn from the CT600 corporation tax return, which must be submitted by companies at least once every twelve months. The data include all tax accounting periods that finish in the tax years 2000-01 to 2014-15 (i.e. between April 6th 2000 and April 5th 2015).

This data is supplemented with information from company accounts from the Financial Accounting Made Easy (FAME) database provided by Bureau van Dijk, also covering the years 2000-01 to 2014-15. These data are from Companies House, the UK company registrar, to which all companies must submit accounts. The accounts data are in two parts. First, the number of directors and number of shareholders are observed at a single point in time – in the most recent year that the company is in the data. This information is matched to the corporate tax record in 98% of cases. Second, information on the company balance sheet is recorded (mostly annually) in company accounts. In 87% of company-years, the corporate tax record is matched to company accounts for the same company with the same start and end date (i.e. in most cases companies file corporate tax records and company accounts that cover the same time period). Those tax records that do not match to company accounts are disproportionately likely to be in the first or last year a company is trading.

The UK tax year runs from April 6th to April 5th. Companies can choose to submit tax returns that cover any period of up to twelve months. In 10% of cases a tax return covers less than twelve months; in the majority of these cases, this is the first or last year

a company is trading. Of the remaining 12 month accounts, around 25% begin in April. In this paper, we take all companies that file at least one corporate tax return ending between April 6th 2012 and April 5th 2015. There are 2.2 million such companies. We are interested in annual flows, and so for comparability we drop tax records covering less than 12 months, which leaves 2.0 million companies.

Table A.1 shows that in 2% of cases information on the number of directors is missing and in 23% of cases the number of shareholders is missing. Table A.2 shows that these companies are disproportionately younger, lower profit and have lower asset values than those with non-missing information. The definition of our company population of interest is based on the number of directors and shareholders. We therefore drop from our analysis companies with missing information on the number of directors or shareholders, leaving us with the 1.6 million companies described as 'All companies' in Table 2.1.

Table A.1: *Distribution of number of directors and shareholders for UK companies*

	Number of shareholders				
Number of directors	1	2	3+	No info.	Total
1	339,504	83,937	18,216	157,625	599,282
2	282,258	387,641	85348	184,596	939,843
3+	125,159	106,128	146,057	94,922	472,266
No info.	2,653	1,426	379	24,397	28,855
Total	749,574	579,132	250,000	461,540	2,040,246

Notes: Includes all companies filing a CT600 tax return covering 12 months in the tax years 2012/13 to 2014/15.
Source: Authors' calculations using HMRC administrative datasets.

Definition of closely held companies

We define our population of interest as companies with (strictly) fewer than 3 directors and (strictly) fewer than 3 shareholders, which is 68% of all companies with non-missing information on the number of directors and shareholders. The purpose of this definition is to capture companies for whom the owners and the managers are the same people. In the FAME database, we do not have information on whether the director and the shareholder are the same person. We therefore use a different dataset (Amadeus), derived from the

Table A.2: *Comparison of companies with and without information on number of shareholders*

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		No shareholder information				Shareholder information			
Source	Variable	Mean	Median	P10	P90	Mean	Median	P10	P90
FAME	Number of directors	2.3	2.0	1.0	4.0	2.2	2.0	1.0	4.0
FAME	Number of shareholders					2.1	2.0	1.0	3.0
FAME	Firm Age (years)	7.2	4.0	1.0	15.0	9.9	6.0	1.0	22.0
CT600	Turnover (£th)	131.1	47.5	4.0	322.5	576.3	106.2	15.5	1,398.4
CT600	Profit (£th)	12.3	1.6	-6.9	53.0	38.5	16.5	-5.0	115.7
CT600	Profit/Turnover (%)	32.3	23.9	2.1	77.1	30.9	22.4	3.6	73.5
CT600	Ever use capital allowances (%)	48.6				69.9			
CT600	Capital allowances (£th)	4.2	1.1	0.1	13.1	14.0	2.5	0.2	38.6
CT600	Capital allowances/Profit (%)	8.0	0.0	-4.2	43.6	12.6	2.4	-0.9	52.3
FAME	Total assets (£th)	172,200.3	26.3	3.0	545.0	624,561.0	70.1	7.0	1,669.4
FAME	Fixed assets (£th)	64,905.1	5.4	0.6	300.3	225,616.8	14.1	1.0	1,041.5
FAME	Current assets (£th)	58,197.2	19.9	2.0	341.3	280,268.3	45.0	4.5	912.1
FAME	Current/Total assets (%)	78.0	93.8	25.2	100.0	72.9	86.5	18.9	100.0
FAME	Shareholder equity (£th)	32,474.9	1.6	-17.1	118.9	135,420.0	10.2	-11.0	514.6
CT600/FAME	Profit/Total assets (%)	98.3	54.4	3.5	278.8	75.3	40.5	3.1	217.1
	Number of companies	461,540				1,578,706			

Note: Table shows descriptives for two samples. The first sample (columns (3)-(6)) contain all companies that operate at some point between 2013 and 2015, have missing information on the number of shareholders and directors, and file 12 month accounts. The second sample (columns (7)-(10)) contains all companies with non-missing information on the number of shareholders and directors. For each company, we observe the variables (listed in column (2)) annually in the data source listed in column (1). For each company we take the mean of each variable across the period of time they are in the data. The statistics shown in the table are mean, median, 10th and 90th percentiles across companies. Mean calculations (across companies, not when constructing company means) are winsorised at the 1st and 99th percentiles.

Source: Authors' calculations using HMRC administrative datasets.

same underlying accounts data submitted to Companies House, and also provided by Bureau van Dijk, which provides information whether the director is also a shareholder. We find that, among UK companies filing accounts, in over 90% of cases: (i) the director and shareholder of a 1 director 1 shareholder company are the same person; (ii) the directors of 2 director, 2 shareholder companies are also shareholders; (iii) one of the directors of a 2 director, 1 shareholder company is also the shareholder.

A.2 Variables

Here we provide definitions of the variables used from corporate tax records and company accounts:

Number of shareholders The number of people that own shares in the company. Dividends are paid out to shareholders.

Number of directors The number of people who are appointed or elected members of the board of the company.

Turnover The total trading turnover (or sales) from any source for the company during the period covered by the tax return.

Profit Turnover net of allowable (for tax purposes) costs including material and salary costs and allowable deductions for plant and machinery investment (capital allowances – see next).

Capital allowance Allowable deductions for plant and machinery investment. See Appendix B for details.

Total assets The total cash value of assets recorded on the company's balance sheet at the end of the accounting period. Includes fixed and current assets.

Fixed assets A fixed asset is defined as a long-term piece of property that a company owns and uses in its operation to generate income, and that is not expected to be consumed or converted into cash in the next year. This includes tangible (e.g. buildings or machinery such as laptops) and intangible assets (e.g. patents). Fixed assets are measured at historic book value (i.e. the price at acquisition net of ongoing accounting depreciation).

Current assets Current assets represent all the assets of a company that are expected to be sold, consumed, utilized or exhausted through the standard business operations, which can lead to their conversion to a cash value over the next one year period. It includes, among other categories, unsold stock, cash on hand and money owed to

the company. In principle, these different components could be observed separately, but in practice they are mostly missing for closely held companies as they are not a mandatory reporting requirement.

Shareholder equity Also known as shareholders' funds. This measures total assets net of liabilities, which include outstanding debt and other money owed to third parties or employees.

A.3 Industries

Table A.3 shows statistics for the top 15 industries in which closely held companies are based.

Table A.3: *Closely held companies in top 15 industries*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Distribution		Median (£th)			Mean % assets
Industry (SIC code)	Number	%	Profit	Turnover	Total assets	held as current
Other business activities (74)	245,592	22.5	25.2	70.5	33.9	82.7
Construction (45)	109,556	10.0	19.0	99.3	40.8	75.7
Computer & related (72)	79,544	7.3	37.1	80.7	32.7	88.6
Retail trade (52)	59,320	5.4	7.3	170.6	59.1	75.4
Real estate (70)	55,165	5.0	6.2	48.1	252.1	45.1
Other service activities (93)	48,110	4.4	9.5	65.6	24.7	69.6
Health & social work (85)	36,413	3.3	26.3	64.9	26.5	73.8
Hotels & Restaurants (55)	34,498	3.2	3.7	156.4	49.3	51.3
Wholesale trade (51)	32,658	3.0	11.8	224.6	108.1	84.7
Rec., culture & sport (92)	26,502	2.4	12.4	61.3	28.8	72.8
Vehicle sale & repair (50)	20,831	1.9	13.5	201.7	72.7	69.4
Land transport (60)	17,910	1.6	8.4	56.5	31.0	65.0
Publishing & printing (22)	13,429	1.2	6.9	64.8	34.1	75.8
Financial intermediation (65)	10,509	1.0	20.9	73.1	41.6	81.3
Manufacture NEC (36)	10,240	0.9	10.9	163.3	77.5	73.6
Total (top 15 industries)	800,277	73.2				

Notes: Closely held companies are classified based on 2-digit SIC code (2003-based). For around 20% of closely held companies, industry classification is not recorded in the data. The table shows the top 15 industries, ranked by the number of closely held companies in each industry. For each company, we take the average profits, turnover and total assets over the period of time we observe them in the data. Columns (4)–(6) show the median values of these variables across closely held companies. All monetary values are in 2014-15 prices. Source: Authors' calculations using HMRC administrative datasets.

Table A.4 shows the number of closely held companies (including the subset with one director and one shareholder) in each industry, as well as the share of companies in that industry that are closely held. This shows that one director, one shareholder companies are disproportionately based in the same industries as the wider set of all closely held companies.

Table A.4: *Number and share of closely held companies in different industries*

(1)	(2)	(3)	(4)	(5)	(6)
	All companies	$\leq$ 2 directors, $\leq$ 2 shareholders		1 director, 1 shareholder	
Industry (SIC code)	Number	Number	Share of industry	Number	Share of industry
Other business activities (74)	329,736	245,592	74.5	81,044	24.6
Construction (45)	145,103	109,556	75.5	29,814	20.5
Computer & related (72)	96,844	79,544	82.1	25,987	26.8
Retail trade (52)	82,992	59,320	71.5	17,649	21.3
Real estate (70)	103,195	55,165	53.5	11,407	11.1
Other service activities (93)	61,081	48,110	78.8	18,254	29.9
Health & social work (85)	47,015	36,413	77.4	13,943	29.7
Hotels & Restaurants (55)	49,447	34,498	69.8	11,728	23.7
Wholesale trade (51)	56,080	32,658	58.2	8,209	14.6
Rec., culture & sport (92)	37,506	26,502	70.7	8,396	22.4
Vehicle sale & repair (50)	29,648	20,831	70.3	5,529	18.6
Land transport (60)	23,650	17,910	75.7	7,582	32.1
Publishing & printing (22)	20,740	13,429	64.7	3,742	18.0
Financial intermediation (65)	19,309	10,509	54.4	3,234	16.7
Manufacture NEC (36)	17,643	10,240	58.0	2,276	12.9
Agriculture & Hunting (01)	17,092	10,200	59.7	2,188	12.8
Education (80)	12,576	9,204	73.2	3,030	24.1
Travel support (63)	12,349	7,738	62.7	2,435	19.7
Metal manufacture (28)	14,075	7,566	53.8	1,392	9.9
Post & telecoms (64)	8,628	6,122	71.0	2,162	25.1
Machinery rental (71)	8,191	5,104	62.3	1,317	16.1
Auxiliary finance (67)	6,924	4,408	63.7	1,591	23.0
Sewage & waste (90)	4,365	3,248	74.4	1,034	23.7
Food & drink manufacture (15)	6,844	3,231	47.2	828	12.1
Equipment manufacture (29)	6,438	2,953	45.9	495	7.7
Electric, gas, steam (40)	4,870	2,136	43.9	585	12.0
Oil & Gas (11)	3,423	2,099	61.3	449	13.1
Wood manufacture (20)	3,095	1,912	61.8	387	12.5
Insurance & pensions (66)	5,152	1,863	36.2	348	6.8
Rubber + plastic manufacture (25)	3,967	1,789	45.1	327	8.2
Research & development (73)	3,271	1,716	52.5	451	13.8
Clothes manufacture (18)	2,476	1,705	68.9	526	21.2
Textile manufacture (17)	2,683	1,671	62.3	421	15.7
Electrical manufacture (31)	3,168	1,516	47.9	282	8.9
Forestry & logging (02)	1,898	1,390	73.2	367	19.3
Chemical manufacture (24)	3,108	1,141	36.7	216	6.9
Other transport manufacture (35)	1,819	1,114	61.2	329	18.1
Fishing (05)	1,723	1,112	64.5	181	10.5
Air transport (62)	1,713	1,101	64.3	297	17.3
Public administration (75)	1,500	1,090	72.7	352	23.5
Precision manufacture (33)	2,532	1,047	41.4	186	7.3
Mineral manufacture (26)	1,972	1,035	52.5	225	11.4
Motor vehicle manufacture (34)	1,487	828	55.7	212	14.3
Membership activity NEC (91)	1,751	794	45.3	230	13.1
Recycling (37)	1,298	775	59.7	218	16.8
Communication manufacture (32)	1,635	766	46.9	151	9.2
Paper manufacture (21)	1,561	727	46.6	134	8.6
Water transport (61)	1,442	623	43.2	118	8.2
Basic metal manufacture (27)	1,298	584	45.0		
Water (41)	704	382	54.3	88	12.5
Leather manufacture (19)	542	324	59.8	89	16.4
Computer manufacture (30)	584	303	51.9	54	9.2
Household as employer (95)	345	276	80.0	111	32.2
Services for household use (98)	387	243	62.8	74	19.1
Other mining (14)	515	186	36.1	35	6.8
Extra-territorial (99)	272	171	62.9	43	15.8
Missing	298,595	200,710	67.2	66,602	22.3

Notes: Firms classified based on 2-digit SIC code (2003-based). Table includes all companies that operate at some point between 2013 and 2015 and have non-missing director and shareholder information. Share of industry (columns (4) and (6)) is the share of all companies in that industry that fit the relevant criteria for the number of directors and shareholders. For basic metal manufacture (27), 1 director 1 shareholder information is blank for reasons of disclosivity.
Source: Authors' calculations using HMRC administrative datasets.

A.4 Personal income tax data

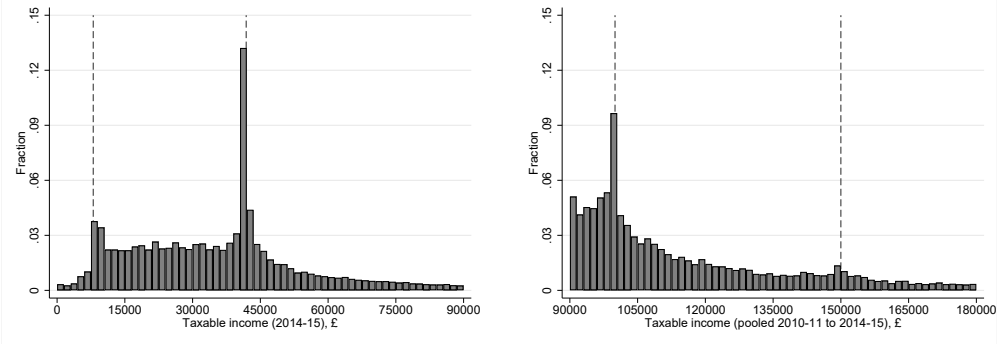
Information on the owner-managers of closely held companies is taken from the universe of self–assessment income tax records, available from 1997-98 to 2015-16. All company directors are required to submit a self-assessment tax return. This data includes information on the taxable incomes of the individuals, the source of that income (e.g. whether it is from employment, dividends or capital gains) and some basic demographic characteristics (age and gender).

Taxable income distribution

Figure 3.1 in the main paper presents the taxable income distribution for matched directors of all closely held companies in 2014-15 up to £90,000, and pooled between 2010-11 and 2014-15 above £90,000. Figure A.1 shows the distributions for matched directors of the subset of closely held companies that have only one director and one shareholder. The distributions do not change markedly across years.

Figure A.1: *Distribution of taxable income for company owner-managers of 1 director, 1 shareholder companies*

(a) Income $\leq$ £90,000 (2014-15) (b) Income $>$ £90,000 (2010-11–2014-15)



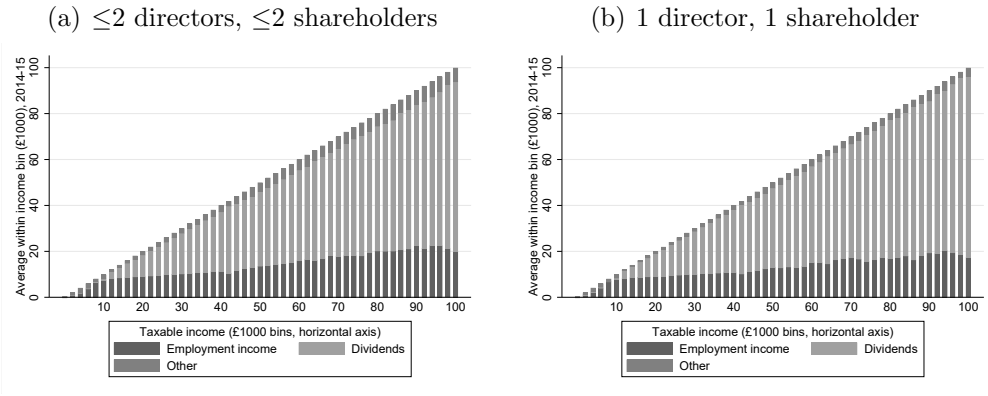
Notes: Black dotted lines indicate increases in marginal rates at the primary threshold and the higher-rate threshold. More details on the tax system are provided in Appendix B. Due to disclosure requirements, we truncate the annual distributions at £90,000, and panel (b) pools observations above £90,000 over the tax years 2010-11 to 2014-15. Bin width is £1500.
Source: Authors' calculations based on HMRC administrative datasets.

Composition of owner-manager taxable income

Figure A.2 shows the composition of taxable income at different income levels for closely held company owner-managers in 2014-15. The increase in taxable income across the

distribution is almost entirely driven by increases in income from dividends, which is consistent with the within-year tax minimizing way to withdraw income from the company described in Section 3.

Figure A.2: *Composition of owner-manager taxable income at different income levels, 2014-15*



Notes: Owner-managers are split into £1,000 bins of taxable income in 2014–15. Figure shows the average of wages, dividends and other income within each bin. Figure (a) does this for all company owner-managers, while (b) does this for the subset whose company has 1 director and 1 shareholder.
Source: Authors' calculations based on HMRC administrative datasets.

A.5 Matching personal and company information

This paper relies on a match between the personal income tax records of company directors and the company's corporate tax returns and accounts.

Details of the match

The match was undertaken by HMRC, the tax authority. They took all directors listed on company accounts in 2013-14 (4.5 million directors), and attempted to match these directors (based on name, date of birth and address) to self-assessment tax records. All company directors are required to submit a tax return, which means that all directors should be in both datasets.

This match was undertaken for directors active at a particular point in time (2013-14). We are able to link both company and personal tax records over time, and so we have the full histories of these directors and their companies from 2005-06. Of the 4.5 million directors, 3.3 million had non-missing information on date of birth and address. Of these,

2.2 million were successfully matched to their self-assessment tax record, giving a match rate of 49% of all directors listed, and 67% of those with non-missing date of birth and address.

Matched companies

Table A.5 compares the sample of all closely held companies (which we define as companies that operate at some point between 2013 and 2015, have non-missing information on the number of shareholders and directors, file 12 month accounts and have $\leq$ two directors and $\leq$ two shareholders) with the subset for which at least one director is successfully matched, and that director has only one directorship (of matched closely held company directors, 10% had more than one active directorship in 2013–14). We note that the sample of all closely held companies is not the set of companies that HMRC tried to match (we do not have the list of companies included in that exercise), but the "matched" companies all fall within this full sample. Table A.5 provides the same comparison for the subset of companies with 1 director and 1 shareholder. 49% of closely held companies and 41% of one director, one shareholder companies have at least one director successfully matched.

The matched companies are similar in terms of company age, have lower (at the mean) turnover and assets, but higher profits. Figure A.3 shows that this is because directors of companies with very low or negative profit are less likely to be successfully matched. Above £5,000, the distribution of profit in the full and matched company samples look similar.

Table A.5: *Comparison of matched closely held companies and the full population*

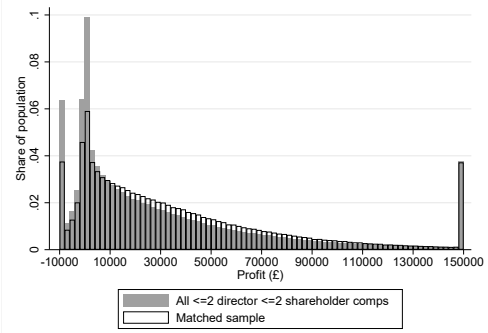
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
		≤ 2 directors, ≤ 2 shareholders								1 director, 1 shareholder							
		Full sample				Matched sample				Full sample				Matched sample			
Source	Variable	Mean	Median	P10	P90	Mean	Median	P10	P90	Mean	Median	P10	P90	Mean	Median	P10	P90
FAME	Number of directors	1.6	2.0	1.0	2.0	1.7	2.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FAME	Number of shareholders	1.4	1.0	1.0	2.0	1.5	2.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
FAME	Firm Age (years)	7.6	5.0	1.0	16.0	8.0	6.0	1.0	16.0	4.0	3.0	1.0	9.0	4.2	3.0	1.0	9.0
CT600	Turnover (£th)	223.6	82.0	14.4	599.1	196.4	87.2	19.3	515.2	123.4	60.7	11.5	303.8	107.1	63.2	15.9	242.4
CT600	Profit (£th)	30.4	16.8	-2.5	88.8	36.7	25.1	-0.4	94.8	21.7	11.7	-2.8	66.9	27.9	19.5	-0.7	74.6
CT600	Profit/Turnover (%)	33.8	27.3	4.4	74.9	36.2	31.4	5.8	75.6	36.5	32.2	4.2	77.3	40.7	39.9	6.2	78.7
CT600	Ever use capital allowances (%)	70.4				79.3				58.7				66.0			
CT600	Capital allowances (£th)	6.3	1.7	0.2	18.4	5.1	1.5	0.2	14.6	4.3	1.3	0.2	13.2	3.3	1.1	0.2	9.9
CT600	Capital allowances/Profit (%)	11.3	2.0	-0.0	46.7	10.5	2.5	0.0	40.6	10.5	0.9	0.0	45.8	9.1	1.1	0.0	37.0
FAME	Total assets (£th)	190.4	42.8	5.7	495.8	117.8	41.6	7.1	320.6	81.6	23.5	3.5	199.8	56.0	24.1	4.5	142.3
FAME	Fixed assets (£th)	90.9	7.2	0.7	244.0	43.6	6.0	0.6	125.6	33.9	4.0	0.6	84.3	17.4	3.1	0.5	45.9
FAME	Current assets (£th)	110.2	30.0	3.7	272.5	75.7	30.6	4.7	200.6	51.8	17.9	2.5	131.2	40.8	19.0	3.0	106.9
FAME	Current/Total assets (%)	75.3	88.7	24.7	100.0	77.1	88.9	32.5	100.0	78.5	93.2	29.8	100.0	80.7	93.9	37.6	100.0
FAME	Shareholder equity (£th)	55.1	6.0	-8.2	152.8	42.5	8.2	-4.1	128.6	17.6	2.2	-7.1	59.0	18.0	3.9	-4.0	61.2
CT600/FAME	Profit/Total assets (%)	92.3	56.7	7.0	249.1	101.1	67.9	11.9	257.4	117.6	78.9	11.0	300.3	128.4	92.6	17.9	306.0
	Number of companies	1,093,340				532,072				339,504				139,362			

Note: Table shows descriptives for four samples. The first sample (columns (3)-(6)) contain all companies that operate at some point between 2013 and 2015, have non-missing information on the number of shareholders and directors, file 12 month accounts and have ≤ two directors and ≤ two shareholders. The second sample (columns (7)-(10)) is a subset of the first column where at least one of the director's tax records is matched to the company records. The third sample (columns (11)-(14)) is a subset of the first sample that have only one director and one shareholder. The fourth sample (columns (15)-(18)) is the subset of the third sample where the director's tax record is matched to the company. For each company, we observe the variables (listed in column (2)) annually in the data source listed in column (1). For each company we take the mean of each variable across the period of time they are in the data. The statistics shown in the table are mean, median, 10th and 90th percentiles across companies. Mean calculations (across companies, not when constructing company means) are winsorised at the 1st and 99th percentiles.

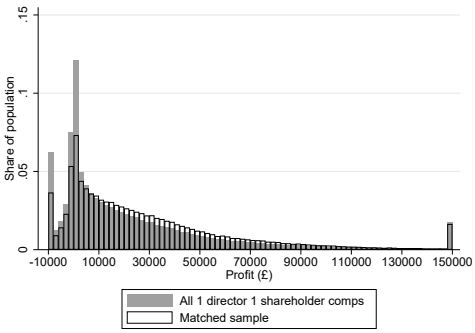
Source: Authors' calculations using HMRC administrative datasets.

Figure A.3: *Distributions of turnover, profits and assets between company populations and matched samples*

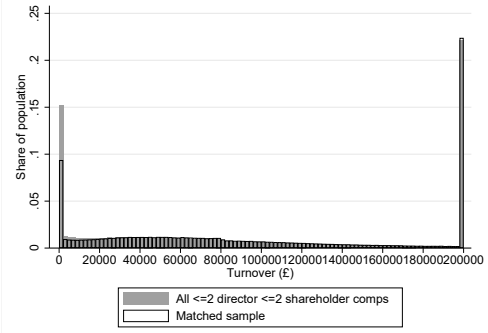
(a) Profit, ≤2 directors, ≤2 shareholders



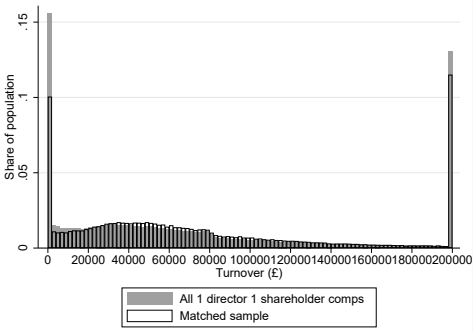
(b) Profit, 1 director, 1 shareholder



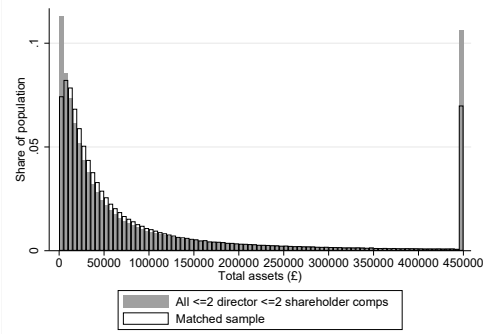
(c) Turnover, ≤2 directors, ≤2 shareholders



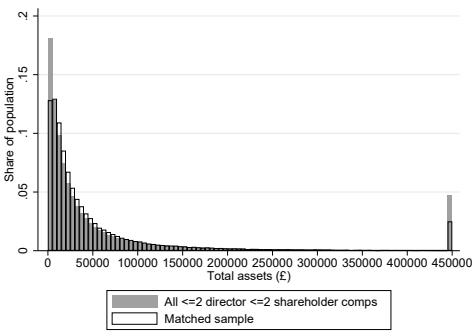
(d) Turnover, 1 director, 1 shareholder



(e) Total assets, ≤2 directors, ≤2 shareholders



(f) Total assets, 1 director, 1 shareholder



Notes: Shows the distributions of mean profit ((a) and (b)), mean turnover ((c) and (d)) and mean total assets ((e) and (f)). Means are calculated at the company level across all years that closely held company is observed. These distributions are based on the subset of companies where at least one director's self-assessment income tax record is matched to the company. Panels (a), (c) and (e) show distributions for all companies with strictly less than 3 directors and strictly less than 3 shareholders, while panels (b), (d) and (f) show the subset with one director and one shareholder. Profit, turnover and assets are truncated at -£10000 and £150,000, £200,000 and £450,000 respectively.
Source: Authors' calculations using HMRC administrative datasets.

A.6 Permanent-transitory income decomposition

We study the extent to which income variation of owner-managers is explained by permanent or transitory components using a simple income decomposition. For the matched sample of one director, one shareholder company owner-managers that are present for at least 5 years, we decompose log total income into a permanent (α) and transitory (ε) component as follows:

$$\ln z_{it} = \alpha_i + \varepsilon_{it} \tag{A.1}$$

where i indexes owner-manager, and t year.

We estimate $var(\ln z_{it}) = 1.481$, and the share of the variation in log total income is due to the transitory component, $\frac{var(\varepsilon_{it})}{var(\ln z_{it})} = 0.43$. We get a similar result if we follow the approach in Kopczuk et al. (2010), who calculate the average variance of log earnings, the variance of five-year average log earnings, and the variance of log earnings deviations (in our case replacing earnings with total income). In comparison, they find that the transitory component explains a much smaller fraction (10%) of overall log earnings variation for all workers in the US.

B Tax system

Rates and thresholds

Table B.1 sets out computed marginal (combined) corporate and personal tax rates for different forms of income. The marginal (combined) effective tax rates calculate the amount of tax paid if the owner-manager earns an extra £ (at the company level) and pays it out either as salary, dividends, or capital gains. In all years, the marginal effective tax rate on capital gains income is above (below) that on dividend income if taxable income is below (above) the higher rate threshold.

Capital allowances

Current expenditure (such as wages and material inputs) is directly deductible from turnover in the calculation of (corporate) taxable profits. For capital expenditure (such

Table B.1: *Calculated combined effective marginal tax rates*

(1) Tax year	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Combined marginal effective tax rate (%)											if taxable income in range:		
	Below PT			PT - HRT			HRT - ART			PA withdrawal		Above ART		
	Salary	Dividends	Cap. gain	Salary	Dividends	Cap. gain	Salary	Dividends	Cap. gain	Salary	Dividends	Salary	Dividends	Cap. gain
2005-06	0.0	19.0	19.0	40.6	19.0	23.5	47.7	39.2	27.1	47.7	39.2	47.7	39.2	27.1
2006-07	0.0	19.0	19.0	40.6	19.0	23.5	47.7	39.2	27.1	47.7	39.2	47.7	39.2	27.1
2007-08	0.0	20.0	20.0	40.6	20.0	24.4	47.7	40.0	28.0	47.7	40.0	47.7	40.0	28.0
2008-09	0.0	21.0	28.9	38.8	21.0	28.9	47.7	40.8	28.9	47.7	40.8	47.7	40.8	28.9
2009-10	0.0	21.0	28.9	38.8	21.0	28.9	47.7	40.8	28.9	47.7	40.8	47.7	40.8	28.9
2010-11	0.0	21.0	28.9	38.8	21.0	28.9	47.7	40.8	28.9	65.4	50.6	56.6	49.5	28.9
2011-12	0.0	20.0	28.0	40.2	20.0	28.0	49.0	40.0	28.0	66.6	50.0	57.8	48.9	28.0
2012-13	0.0	20.0	28.0	40.2	20.0	28.0	49.0	40.0	28.0	66.6	50.0	57.8	48.9	28.0
2013-14	0.0	20.0	28.0	40.2	20.0	28.0	49.0	40.0	28.0	66.6	50.0	53.4	44.4	28.0
2014-15	0.0	20.0	28.0	40.2	20.0	28.0	49.0	40.0	28.0	66.6	50.0	53.4	44.4	28.0

Note: This table sets out the combined (personal and corporate) marginal tax rate for an owner-manager earning an extra £at the corporate level and paying it out either as salary, dividends or capital gains. Table assumes that company has annual profits below £300,000 (and therefore faces the small profits rate). The combined marginal tax rate on salary is computed as the tax due from an extra £paid by an employer (including income tax, employee NICs and employer NICs). Combined marginal tax rate on dividends and capital gains are calculated as corporate tax rate+(1−corporate tax rate)∗dividend tax rate and corporate tax rate+(1 − corporate tax rate) ∗ capital gains tax rate respectively. Over the range of income where the personal allowance is being withdrawn, the marginal tax rate is higher because, for every £earned, 50p of personal allowance is withdrawn so an extra 50p of income is taxed at the higher rate.
Source: Various government documents. Authors' calculations.

as on buildings and machinery that depreciate over time), companies can claim capital allowances.

From 2008-09, the UK has operated an Annual Investment Allowance (AIA), which provides 100% upfront deduction for plant and machinery investment up to an annual cap (which varied between £25,000 and £500,000 across years). Plant and machinery expenditure above this allowance is 'written down' on a (currently 18%) declining-balance basis. In practice most closely held companies are able to deduct 100% of their plant and machinery investments using the AIA (i.e. in the year the expenditure is incurred).

Prior to 2008, the capital allowances regime was less generous than the AIA but small and medium-sized companies still tended to get allowances that were greater than economic depreciation. Most closely-held businesses would have been able to claim a 50% first year allowance for all of their plant and machinery investments, meaning that half of the expenditure could be deducted in the calculation of corporate profit in the year the investment was made, while the remainder would be deducted on a declining balance basis (25%). As an example, for an investment of £100, £50 would be deducted in the first year, £12.50 in the second year (25% of £50), £9.38 (25% of £37.50) in the third year and so on.

C Theoretical analysis

Here we provide analyze a simple model to formalise the intuition for the various ways that owner-managers may respond to tax, summarised in Section 3.

C.1 Model set-up

Owner-managers maximise the expected net present value of lifetime utility, which is derived from consumption, c_t, and labour supplied, l_t, in each period, t:

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^t[u(c_t)-\psi(l_t)], \tag{C.1}$$

where β denotes the standard discount factor, $u(\cdot)$ is a well-behaved concave per-period utility function, and $\psi(\cdot)$ is a convex function denoting the disutility from working.

They produce total income, $z_t = f(k_t, l_t, \eta_t)$, as a function of labour, l_t and capital, k_t; the production process is also subject to time varying mean zero shocks, η_t. Taxable income (at the personal level), y_t, is equal to total income (at the company level and net of corporate tax), z_t, minus the net retention of cash assets, a_t, and investment in capital, i_t: $y_t = z_t - a_t - i_t$. [40] Consumption equals taxable income minus tax paid (which depends on the tax function, $\mathcal{T}$) and any further net saving or borrowing at the personal level, s_t: $c_t = y_t - \mathcal{T}(y_t) - s_t$.

Owner-managers enter each period with capital, k_t, cash assets held in the company, A_t, and cash assets held at the personal level, S_t. The laws of motion for these three assets are:

$$k_{t+1} = (1 - \delta)k_t + i_t \tag{C.2}$$

$$A_{t+1} = (1 + r)(A_t + a_t) \tag{C.3}$$

$$S_{t+1} = (1 + r)(S_t + s_t) \tag{C.4}$$

where we assume that capital depreciates at a rate, δ, and the rate of return on cash assets is equal to r, regardless of whether it is held in the company or at the personal level.[41] We also assume that owner-managers are subject to borrowing constraints at both the personal and company level, $S_{t+1} \geq \underline{S}$ and $A_{t+1} \geq \underline{A}$.

Owner-managers choose $\{l_t, k_{t+1}, A_{t+1}, S_{t+1}\}_{t=0}^{\infty}$ to maximise (C.1) subject to the period budget constraints, the laws of motion (C.2) – (C.4), and the borrowing constraints.

[40] For expositional ease, we abstract from the corporate tax rate. In practice, some investment is deductible from z_t before corporate tax is applied, with a_t denoting retention out of post-corporate tax profit. Adding a constant and linear corporate tax rate does not change the analysis below.

[41] To simplify the analysis, we assume that r – the post-personal tax rate of return – is common across assets held inside and outside of the company. In practice, they could differ, including as a result of the tax treatment of different types of personal savings vehicles. However, in the short run, we expect such differences to be small and not to affect the costs of (and therefore deadweight loss associated with) short run income shifting (to smooth volatility).

The first order conditions are:

$$u_{ct} \cdot f_{lt} \cdot (1 - \mathcal{T}'_t) = \psi'_t \tag{C.5}$$

$$u_{ct} \cdot (1 - \mathcal{T}'_t) = \beta \mathbb{E}[u_{ct+1} \cdot (f_{kt+1} - (1 - \delta)) \cdot (1 - \mathcal{T}'_{t+1})] \tag{C.6}$$

$$u_{ct} \cdot (1 - \mathcal{T}'_t) = \beta(1 + r)\mathbb{E}[u_{ct+1} \cdot (1 - \mathcal{T}'_{t+1})] + \lambda^A_t \tag{C.7}$$

$$u_{ct} = \beta(1 + r)\mathbb{E}[u_{ct+1}] + \lambda^S_t \tag{C.8}$$

where u_{ct} denotes the marginal utility of consumption in period t; f_{lt} denotes the marginal product of labour in period t; $\mathcal{T}'_t$ denotes the marginal tax rate paid in period t; λ^A_t and λ^S_t denote the Lagrange multipliers on the borrowing constraints.

C.2 The effect of taxation on behaviour

It is straightforward to see that when the tax function is a constant linear function of taxable income, $\mathcal{T}(y_t) = \tau_0 y_t$, then the problem reduces to a standard consumption-labour model with investment and saving. In each period, owner-managers choose labour supply such that the post-tax marginal product of labour, converted into utils, equals the marginal disutility from working (equation (C.5)). The tax rate drops out of conditions (C.6) – (C.8) i.e. intertemporal allocations are unaffected. The owner-manager is indifferent between saving (or borrowing) in the company or at the personal level, and does so to smooth the marginal utility of consumption over time, $u_{ct} = \beta(1+r)\mathbb{E}u_{ct+1}$ (assuming the borrowing constraints do not bind). Combining this condition with (C.6) yields the standard result that owner-managers invest such that the net return on capital equals the return on cash investments, $f_{kt+1} - (1 - \delta) = 1 + r$.

When the tax system deviates from the constant rate (i.e. when there is a kink and/or different tax rates on dividend and capital gains income), there are incentives for owner-managers to shift taxable income intertemporally, which can lead to distortions in the inter (as well as intra) temporal allocation of resources. To illustrate this, we consider a piecewise linear tax function:

$$\mathcal{T}(y_t) = \tau_0 \min(y_t, y^K) + \tau_1 \max(y_t - y^K, 0) \tag{C.9}$$

i.e. taxable income up to the kink point, y^K, is taxed at the lower rate, τ_0, with income above that point taxed at a higher rate, τ_1. We additionally assume that all owner-managers have access to an intermediate rate of tax, $\tau_k \in [\tau_0, \tau_1)$ in some future period(s). This captures the fact that all owner-managers can withdraw income in the form of capital gains on company liquidation, accessing a lower rate of tax than the higher rate applied to dividends; owner-managers may also choose to draw down a stock of retained profits as dividend income (such that taxable income remains below y^K) once they have ceased working.

This particular system is broadly representative of the system faced by owner-manager in practice. However, the incentives that we describe below apply more widely, for example, if owner-managers expect variation in the tax rate across time.

The questions in which we are interested are: (i) how do owner-managers with different preferences and constraints respond to the variation in marginal rates across time and income levels? And (ii) do these responses create distortions to the allocations of consumption, labour or capital? Let $l^*(k_t, A_t, S_t, \eta_t)$ and $c^*(k_t, A_t, S_t, \eta_t)$ denote the optimal policy functions for labour supply and consumption choices, respectively, given a linear tax rate, τ_0. Analogously, let $l^{**}(k_t, A_t, S_t, \eta_t)$ and $c^{**}(k_t, A_t, S_t, \eta_t)$ denote the optimal policy functions when owner-managers are faced with the kinked tax function. We define distortionary responses to be those that lead the optimal labour and consumption paths to differ under the kinked tax function i.e. $l^* \neq l^{**}$ and/or $c^* \neq c^{**}$, since these are the determinants of utility. We conduct our analysis relative to the constant linear tax rate τ_0 because our empirical setting allows us to study the effects of the higher rate above y^K relative to the lower rate, rather than the effect relative to a zero tax world. However, the intuition for the behaviour we describe below can easily be applied in the setting where $\tau_0 = 0$.

Shifting to smooth volatile incomes

Consider an agent whose average total income is less than the kink, $\bar{z}^* < y^K$, and further assume that $\beta = \frac{1}{1+r}$. Consumption smoothing thus implies that optimal consumption in

each period will fall below the kink $c^* < y^K$. Now suppose that there are some periods in which $z_t^* > y^K$ (due to the shocks, η_t). In these periods, the owner-manager optimally (in the absence of the kink) would set $s_t = z_t^* - c_t^*$ i.e. they would want to save their higher than usual income. Now, in the presence of the kink, they can simply set $a_t = z_t^* - y^K$ instead, and $s_t = y^K - c_t^*$. In this way, the agent ensures that they never pay the higher rate of tax, and therefore they have no incentive to change labour supply (as $\mathcal{T}_t' = \tau_0$ in all periods).[42] Their consumption in each period is the same as in the absence of the kink. A similar argument applies to owner-managers with average total income at or above the kink. These owner-managers may adjust their labour supply and hence total income in the face of the higher tax rate (more on this below), but, conditional on this lower value of $\bar{z}^{**}$, the shifting that they may do to smooth out any volatility does not itself create distortions.

Shifting to take advantage of a lower future tax rate

Owner-managers with $\bar{z}^* \geq y^K$ have an incentive to shift taxable income across time in order to access a lower tax rate, $\tau_k < \tau_1$, in some future period, $\bar{T}$. If $\tau_k > \tau_0$ (i.e. if the rate below the kink is lower than the rate available in a future period), owner-managers with average total income above the kink may reduce their labour supply (see below). Conditional on z^{**}, however, whether this type of retention response leads to a distortion in the intertemporal allocation of resources depends on whether owner-managers face personal borrowing constraints.

If owner-managers are not borrowing constrained i.e. $\lambda_t^S = 0$, then they can adjust taxable income so that $y_t^{**} = y^K$ (i.e. they bunch) in all t. The intertemporal allocation of consumption is not affected because they can borrow to fund today's consumption above current income.

However, now consider agents with $\bar{z}^* \geq y^K$, who are borrowing constrained ($\bar{z}^* - y^K \geq \underline{S}$) such that if they retained all income above the kink in the company, they could not borrow at a personal level in order to keep consumption today as high they would like. We

[42] The derivative of the tax function, $\mathcal{T}_t'$ is not defined at the kink; however, this result holds if agents set $y_t = y^K - \varepsilon$, for some arbitrarily small ε when $z_t^* > y^K$.

think this a plausible situation given that many owner-managers report taxable income above the kink, which would not be optimal if they could costlessly borrow against income held in the company. Owner-managers who are borrowing constrained face a kink in their intertemporal budget constraint: consuming an extra dollar below $y^K + \bar{S}$ costs $(1+r)^{\bar{T}}$ dollars $\bar{T}$ periods in the future, but consuming an extra dollar today above $y^K + \bar{S}$ costs $\frac{1-\tau_0}{1-\tau_1}(1+r)^{\bar{T}}\big(> (1+r)^{\bar{T}}\big)$. The optimal amount owner-managers choose to retain depend on their marginal rate of substitution between today and the future.

Let $MRS(y_t|\mathbf{z}) = \frac{u_{ct}}{\beta^{\bar{T}}\mathbb{E}u_{ct+\bar{T}}}$ denote the marginal rate of substitution between consumption today and consumption in the future period $\bar{T}$ (at which point τ_k is available). It depends on the taxable income chosen today, y_t, and is conditional on the stream of future total income flows. $MRS(y_t|\mathbf{z})$ is declining in y_t; in the absence of the kink, y_t is chosen such that $MRS(y_t|\mathbf{z}) = (1+r)^{\bar{T}}$ (i.e. the slope of the intertemporal budget constraint). The kink in the intertemporal budget constraint creates an incentive for agents for whom $(1+r)^{\bar{T}} \leq MRS(y^K) \leq \frac{1-\tau_0}{1-\tau_1}(1+r)^{\bar{T}}$ to bunch at y^K. The "marginal buncher" is the agent for whom $MRS(y^K) = \frac{1-\tau_0}{1-\tau_1}(1+r)^{\bar{T}}$. There is also an incentive for owner-managers with $MRS(y^K) > (1+r)^{\bar{T}}\frac{1-\tau_0}{1-\tau_1}$ to reduce their taxable income today (i.e. retain more) given the higher cost of consuming today relative to consuming tomorrow.

Investment

As highlighted in Section 3, personal taxes do not directly affect the incentive to use retained profits to invest in productive capital. This can be seen in the theoretical model by analysing the first order conditions for the different asset choices. As discussed above, the kink in the tax schedule creates a kink in the intertemporal budget constraint. This means that owner-managers who would (in the absence of the kink) set taxable income today above the kink, instead may retain (and may also adjust labour supply) such that $\frac{u_{ct}}{\beta^{\bar{T}}(1+r)^{\bar{T}}\mathbb{E}u_{ct+\bar{T}}} \leq \frac{1-\tau_k}{1-\tau_1}$ (where $\bar{T}$ denotes the number of periods in the future the owner-manager expects to access τ_k) with a strict inequality for owner-managers bunching at the kink. For these agents, substitution in to equation (C.6) yields the same condition for capital choice as in the absence of the kink, i.e. $(1+r)^{\bar{T}} = (f_{kt+\bar{T}} - (1-\delta))^{\bar{T}}$ such

that the return on the assets within the company are optimally equalised.[43] Although some owner-managers are willing to consume less today than tomorrow (because of the kink in the intertemporal budget constraint), this does not also lead to misallocation in their asset choice within the company. As discussed further in the main text, this result rests on the assumption that there is a constant return to saving in the cash asset, r, that does not depend on the amount saved.

D Empirical analysis

D.1 Data samples

In this paper we take as our starting point all companies who file a 12 month corporate tax account finishing between 2012-13 and 2014-15 with non-missing information on directors and shareholders (we refer to this as the "full company population"). The data cover tax years 2005-06 to 2014-15. Our population of interest are the owner-managers of closely-held companies, which we define as those with $\leq$2 directors and $\leq$ 2 shareholders.

In the empirical analysis in Section 4 we study those companies for which we have matched (at least one of) the directors' personal tax records and where the director is the director of only one company (we refer to this as the "matched sample"). For a subset of the empirical analysis, we use only one director, one shareholder companies as this allows us to attribute total income of the company to the owner-manager. In our bunching analysis, we consider the set of matched one director one shareholder companies observed for at least three years.

Table D.1 shows the number of companies, number of directors and number of observations in various samples, including those used as a basis for our analysis. The samples listed in italics are those used as a basis of the analysis in Section 4: $\leq$ 2 directors, $\leq$2 shareholder sub-samples refer to the years in which a company is observed: we demonstrate the sensitivity of our diff-in-diff results to this in Appendix D.3. Note that the

[43]Note that recursion implies $u_{ct}(1-\tau_1) = \beta^{\bar{T}}\mathbb{E}[u_{ct+\bar{T}}(f_{kt+\bar{T}} - (1-\delta))^{\bar{T}}(1-\tau_k)]$. Substitute in $u_{ct} = \beta^{\bar{T}}(1+r)^{\bar{T}}\mathbb{E}u_{ct+\bar{T}}\frac{1-\tau_k}{1-\tau_1}$ yields $\mathbb{E}[u_{ct+\bar{T}}(1-\tau_k)\big((1+r)^{\bar{T}} - (f_{kt+\bar{T}} - (1-\delta))^{\bar{T}}\big]$.

samples on which the regressions are estimated (Table D.3) are smaller than those listed here, as they condition on the director or company being either in the treatment or control group.

Table D.1: *Samples used in analysis*

(1)	(2)	(3)	(4)
Sample	Companies	Directors	Observations
Full company population	2,040,246	-	17,383,854
≤ 2 directors ≤ 2 shareholders	1,093,340	-	7,268,792
Matched sample	533,592	636,676	3,671,484
Observed 2009–2014	245,789	300,195	2,641,688
Observed 2008–2014	207,778	254,980	2,347,250
Observed 2007–2014	175,234	215,638	2,048,410
Observed 2006–2014	128,823	158,239	1,546,452
Balanced panel	108,020	131,642	1,316,420
1 director, 1 shareholder	339,504	-	1,201,526
Matched sample	139,362	139,362	520,064
Observed 3+ years	81,792	81,792	430,035

Note: The table shows the number of companies, number of directors (where applicable) and number of observations in different samples used in this paper.
Source: Authors' calculations using HMRC administrative datasets.

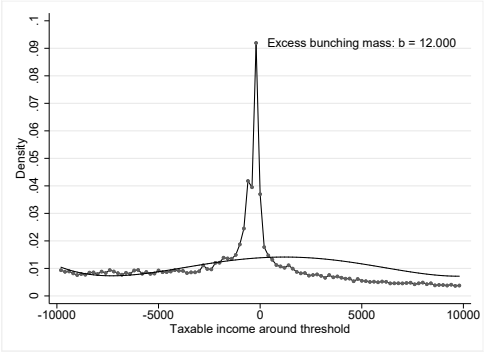
D.2 Bunching estimation

In our bunching analysis in Section 4.1 we use the sample of one director, one shareholder companies that are present in the data for at least three years. This is so we can analyze their average total income, and also calculate the fraction of years that we observe them bunching, in order to distinguish between different motivations for intertemporal shifting. Figure D.1 shows that the distributions of taxable income for the full sample (present for any number of years), and the sample of those present for at least three years is very similar.

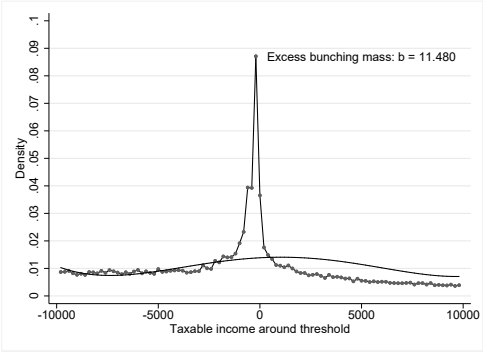
In our main bunching results, to construct the counterfactual distribution, we fit a polynomial of degree 4 through the observed distribution, excluding a window of 7 bins (i.e. £1400) either side of the threshold. Table D.2 shows the robustness of our estimates to varying the size of the excluded window and degree of polynomial; differences in the estimated bunching mass are small.

Figure D.1: *Bunching in annual taxable around the higher rate threshold, one director one shareholder companies*

(a) Present for at least one year



(b) Present for at least three years



Notes: Method for estimating the counterfactual density described in the main paper. Bin width is £200. The left hand panel shows the distribution of annual taxable income for the owner-managers of one director one shareholder companies present for any number of years; the right hand panel shows the distribution for the sample of owner-managers of one director one shareholder companies who are present in the data for at least 3 years; more details on sample definition are provided in Appendix D.1.
Source: Calculations based on HMRC administrative datasets.

Table D.2: *Robustness to the parametrization of the counterfactual distribution*

	(1)	(2)	(3)	(4)	(5)	(6)
		Excluded window		Polynomial degree		
	Baseline	£1000	£2000	5	6	7
Bunching mass:						
Annual taxable income	11.480	11.440	10.600	11.390	9.832	9.796
Annual total income	-0.069	-0.010	0.088	-0.071	-0.151	-0.153
Average total incomes	-0.012	-0.065	-0.009	-0.106	-0.044	-0.036

Notes: Method for estimating the counterfactual density described in the main paper. Bin width in all specifications £200. Each column shows a different parametrization of the counterfactual density. Column (1) shows the baseline specification, which has an excluded window of 7 bins, or £1400, and uses a polynomial of degree 4. Columns (2)-(3) show the results when the excluded window is varied; and columns (4)-(6) show the results when the degree of polynomial is varied. All specifications use the sample of one director one shareholder companies who are present in the data for at least 3 years.
Source: Calculations based on HMRC administrative datasets.

D.3 Differences-in-differences analysis

Table D.3 shows the coefficient estimates underlying Figures 4.4 and 4.7.

Table D.3: *Differences-in-differences coefficient estimates*

(1)	(2) $\ln y_{it}$	(3) $\ln \pi_{ft}$	(4) $A_{ft} - A_{ft-1}$	(5) i_t
Pre-reform				
Treatment*2006	0.0274	0.0769		
	(0.0090)	(0.0244)		
Treatment*2007	0.0079	0.0521	4421.1	0.00686
	(0.0081)	(0.0224)	(1133.8)	(0.00880)
Treatment*2008	0.0016	0.0148	2286.9	0.00798
	(0.0071)	(0.0218)	(1080.2)	(0.00858)
Treatment*2009	0.0000	0.0000	0.0	0.00000
	–	–	–	–
Reform announced				
Treatment*2010	0.0132	0.0520	-3357.5	0.00541
	(0.0113)	(0.0233)	(1127.9)	(0.00776)
Reform implemented				
Treatment*2011	-0.2489	0.0365	1683.9	0.00867
	(0.0115)	(0.0244)	(1137.5)	(0.008821)
Treatment*2012	-0.2620	0.0250	8547.1	0.02090
	(0.0127)	(0.0255)	(1079.8)	(0.00853)
Treatment*2013	-0.2876	-0.0133	8952.5	0.00458
	(0.0134)	(0.0270)	(1114.3)	(0.00819)
Treatment*2014	-0.2704	0.0078	6640.3	0.00802
	(0.0136)	(0.0281)	(1137.6)	(0.00835)
Treatment*2015	-0.2920	-0.0073	6372.5	0.0139
	(0.0154)	(0.0327)	(1240.0)	(0.00903)
Year effects	Yes	Yes	Yes	Yes
Fixed effects	Director	Company	Company	Company
Number of directors	32,847			
Number of companies		28,843	29,224	29,224
Number of observations	318,254	235,023	256,014	257,182

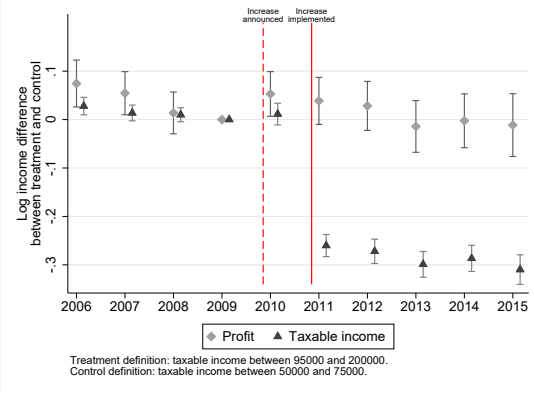
Notes: Table shows the coefficient estimates from the estimated equations (4.1)-(4.3) (columns (2)–(4)) and (4.4) column (5). Robust standard errors are show in parentheses. There are more directors than companies because some companies have two directors. $\ln \pi_{ft}$ *is missing if* π_{ft} *is negative. The dependent variable in columns (4) and (5) are changes from the previous year, so the interaction with the first year is not identified.*
Source: Calculations based on HMRC administrative datasets.

Income cutoffs

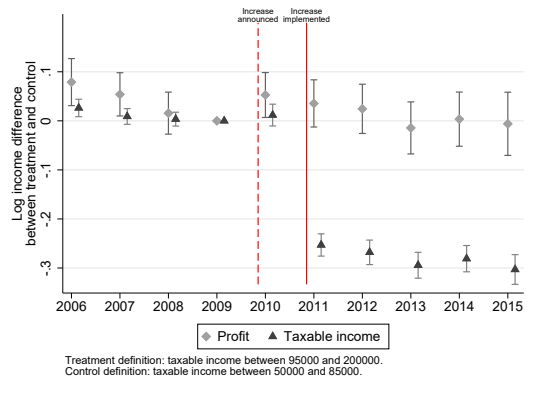
We define the treatment and control groups on the basis of the taxable income of owner-managers in the pre-reform period. Figure D.2 shows robustness to alternative income cutoffs used to define the treatment and control groups.

Figure D.2: *Robustness to alternative treatment and control group definitions*

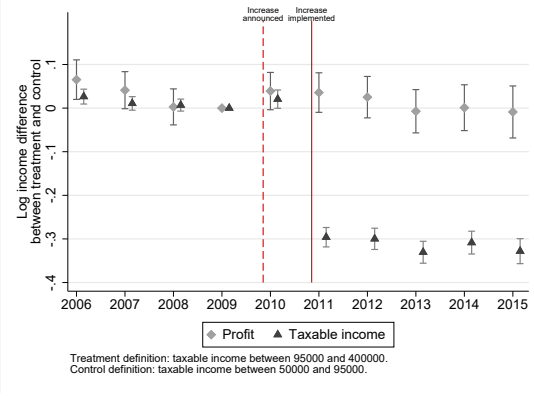
(a) Control: £50–75k. Treatment: £95–200k



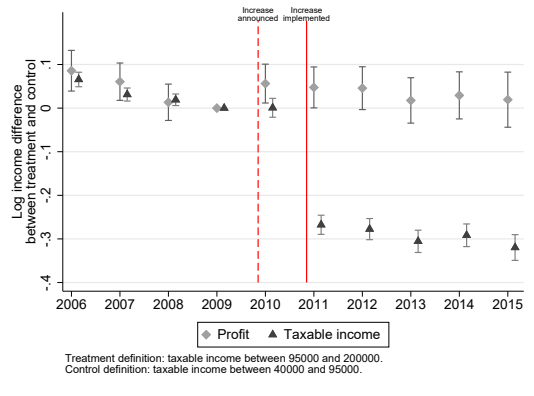
(b) Control: £50–85k. Treatment: £95–200k



(c) Control: £50–95k. Treatment: £95–400k



(d) Control: £40–95k. Treatment: £95–200k



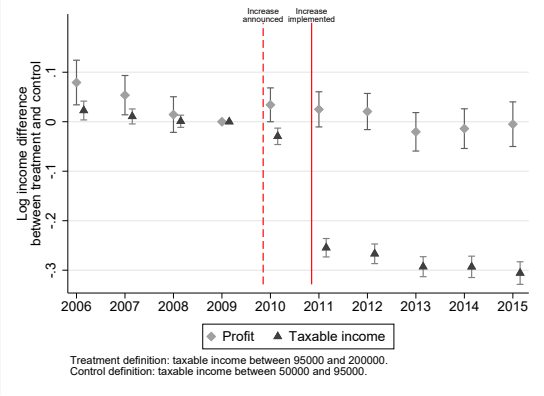
Notes: Each panel shows the estimated $\beta_s^{taxable}$ coefficients from equation (4.1); grey markers show the estimated β_s^{profit} coefficients from equation (4.2) using different income cutoffs to define the treatment and control groups. In all cases, the treatment and control groups are defined as owner-managers with incomes always within the specified ranges during the pre-reform period (2006-2009). The omitted year in all cases is 2009. Error bars show 95% confidence intervals. Years on the horizontal axis refer the calendar year in which the tax year ends i.e. 2007 refers to the tax year starting in April 2006 and ending in March 2007.
Source: Calculations based on HMRC administrative datasets.

Balanced and unbalanced panels

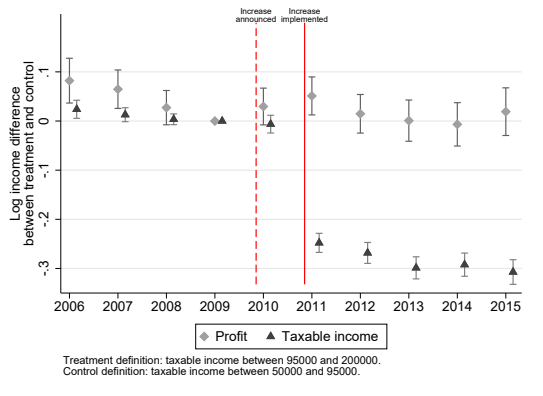
In our baseline estimate we require that we observe owner-managers for the full pre-reform period (i.e. over 2005/6 to 2008/9 tax years) to construct the treatment and control groups. Panels (a)–(c) of Figure D.3 show that our results are robust to relaxing this requirement to only observing owner-managers in at least 1, 2, and 3 years of the pre-reform period. Finally, panel (d) of D.3 shows that we get similar results when we use a balanced panel.

Figure D.3: *Robustness to alternative treatment and control group definitions*

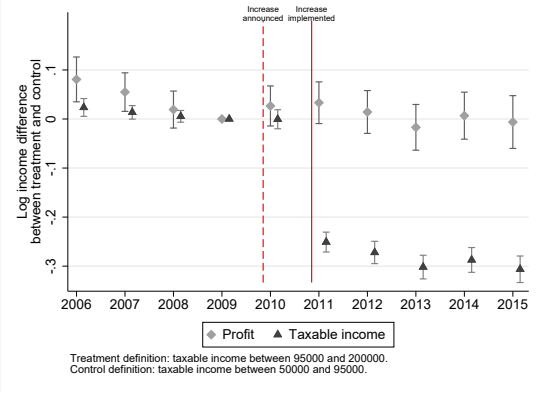
(a) At least 1 year in pre-reform period



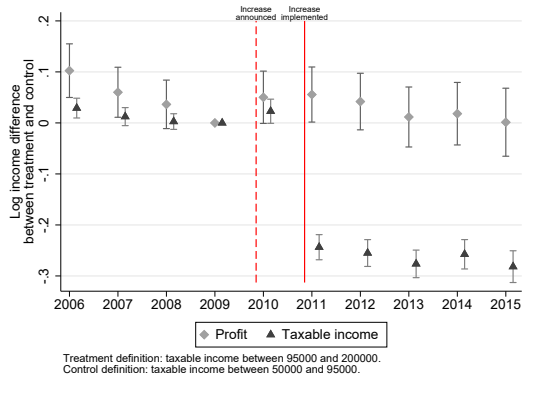
(b) At least 2 years in pre-reform period



(c) At least 3 years in pre-reform period



(d) Balanced panel



Notes: Each panel shows the estimated $\beta_s^{taxable}$ coefficients from equation (4.1); grey markers show the estimated β_s^{profit} coefficients from equation (4.2) varying the requirements to be in the sample. In all cases, the treatment and control groups are defined as in the baseline case (treatment: £95–200k, and control: £50–95k). Error bars show 95% confidence intervals. Years on the horizontal axis refer the calendar year in which the tax year ends i.e. 2007 refers to the tax year starting in April 2006 and ending in March 2007.
Source: Calculations based on HMRC administrative datasets.