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Responsiveness of corporation tax revenues to taxable income: a firm-level approach

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Abstract: Revenues from the taxation of corporate profits are a large and rapidly growing source of total government funding in Ireland. This report is the first to use firm-level administrative data to estimate how corporation tax revenues respond to changes in taxable income. The paper uses a newly constructed data source on all firms filing corporation tax returns over time from 2009 to 2018. We use an analytical approach to estimate the relationship between a firm's corporation tax liabilities and their taxable income. Our baseline estimate for the aggregate tax revenue elasticity is 1.3 with this figure displaying a slight upward trend over time.

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EXECUTIVE SUMMARY

Revenues from the taxation of corporate profits are a large and rapidly growing source of total government funding in Ireland and this has raised concerns regarding its sustainability and volatility. Understanding the factors that impact corporation tax revenues and how they respond to changes in taxable income is therefore an important input into forecasting government revenues and assessing economic risks.

While a number of papers have used macroeconomic data to estimate the relationship between corporation tax revenues and its tax base, this report is the first to use firm-level administrative data to calculate the elasticity of corporation tax relative to taxable income. The analysis is based on a newly constructed data source from the Revenue Commissioners that captures the full population of firms that file corporation tax returns over time.

We use an analytical approach to estimate the relationship between a firm's corporation tax liabilities and their taxable income. The literature indicates this relationship can be affected by three main factors: the built-in 'fiscal drag' properties of the corporation taxation system (in other words, the automatic change in revenues as the tax base changes); changes in discretionary policy that affect the difference between gross and net tax liabilities; and changes in compliance effort.

Our baseline estimate for the aggregate tax revenue elasticity is 1.3. This implies that for every 1 per cent increase in the tax base, tax liabilities automatically increase by 1.3 per cent. Looked at on an annual basis, we find a slight upward trend over time with the elasticity increasing from 1.25 per cent in 2009 to 1.34 in 2018. This suggests that the built-in 'fiscal drag' properties of the corporation tax system have slightly increased over time. Discretionary policy changes play no part in the interpretation of the tax revenue elasticity as they are held constant by definition.

We also find that there are considerable differences in firm income growth across the income distribution, but that this has a minimal impact on the aggregate revenue elasticity estimate. This result is potentially important in that it suggests the strong income growth performance of the largest taxpayers, which are significant given the well-flagged concentration of CT, has little bearing on fiscal drag for this tax head.

1: Introduction

Revenues from the taxation of corporate profits are a large and rapidly growing source of total government funding in Ireland and this has raised concerns relating to its sustainability and volatility. Understanding the factors that impact corporation tax revenues and how they respond to changes in taxable income is therefore an important input into forecasting government revenues and assessing economic risks.

This report is the first to use firm-level administrative data to calculate the elasticity of corporation tax relative to taxable income in Ireland. The analysis is based on a newly constructed data source from the Revenue Commissioners that captures the full population of firms liable for corporation tax over time and is therefore both unique and comprehensive in its coverage. It provides a rich resource amalgamating corporation tax returns and employers' tax returns over the period 2009 to 2018. Over the full period there are 256,945 distinct firms and on average 136,667 firms file a return each year.

This research builds on a number of micro-founded revenue elasticities papers including estimations of income tax revenue elasticities (Acheson, Deli, Lambert and Morgenroth, 2017) and of VAT revenue elasticities (Acheson, Deli, Lambert, Morgenroth and Murphy, 2018). This report is the first to use microdata across the full corporate income distribution to estimate revenue elasticities for corporation taxes in Ireland.

Internationally, there is an extensive literature on the response of investments (especially foreign direct investments) and tax revenues to changes in the corporation tax rate but relatively little on the responsiveness of tax liabilities to changes in the tax base (profit). This latter responsiveness is the focus of this report. We use an analytical approach to estimate the relationship between corporation tax liabilities and the tax base.

Tax revenues may change due to a variety of factors and, in this work, we focus on estimating a tax elasticity, which measures the responsiveness of tax revenue to changes in the tax base, keeping all other parameters (including tax legislation concerning discretionary tax policy changes and compliance efforts) constant. This is related to but distinct from tax buoyancy which measures the total response of tax revenue both to changes in the tax base and to discretionary changes in tax policies over time. The tax elasticity indicates the built-in 'fiscal drag' properties of the corporation tax system and is the relevant measure for tax forecasting which is a key objective motivating this research. It is also a counterfactual measure, meaning its estimation requires either that data be adjusted to remove the effects of discretionary policy changes (which is common for macro econometric estimates), or that the method of estimation relies on in-year data only in which

the policy landscape is held constant (which is common for analytical estimates).³

Our baseline estimate for the aggregate tax revenue elasticity is 1.3. This implies that for every 1 per cent increase in the tax base, tax liabilities automatically increase by 1.3 per cent. Looked at on an annual basis, we find a slight upward trend over time with the elasticity increasing from 1.25 per cent in 2009 to 1.34 in 2018. This suggests that the built-in ‘fiscal drag’ properties of the corporation tax system have slightly increased over time. Discretionary policy changes play no part in the interpretation of the tax revenue elasticity as they are held constant by definition.

We also find that there are considerable differences in income growth across the income distribution, but that this has a minimal impact on the aggregate revenue elasticity estimate. This result is potentially important in that it suggests the strong income growth performance of the largest taxpayers, which are significant given the well-flagged concentration of CT, has little bearing on fiscal drag for this tax head.

The remainder of the report is organised as follows: Section 2 gives an overview of the key elements of the Irish corporation tax system, describes the calculations of corporation tax liabilities and provides summary statistics on the tax liability data. Section 3 provides the calculations for the analytical estimation of corporation tax elasticities and explores the role of income dynamics underlying these relationships. Finally, Section 4 concludes and discusses the findings.

2: Overview of Irish Corporation Tax System

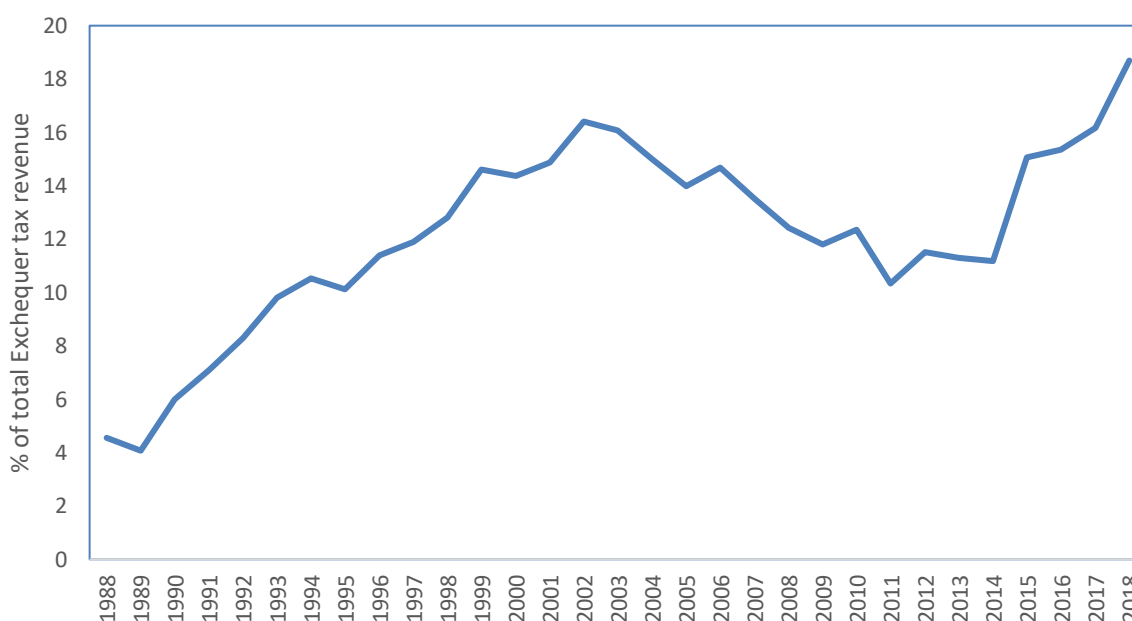
2.1 Irish Corporation Taxation System

Corporation tax receipts make up a sizeable proportion of Irish government revenues and their importance in this regard has increased considerably over time. Figure 1 shows a steady increase in the share of exchequer funding coming from corporation tax throughout the 1990s, from a starting point of around 4 per cent in 1989 to a first peak of 16 per cent in 2002 and 2003. There followed a slight decline in the relative importance of corporation tax during the housing boom of the mid-2000s when taxes generated by the construction industry such as stamp duties increased sharply. The share of corporation tax in total exchequer funds continued to decline during the subsequent recessionary years reaching a low point of 10 per cent in 2011. There followed a dramatic increase in the share of receipts coming from corporation tax, with a jump from 11 per cent in 2014 to 15

³ The discretionary policies in question refer only to those that impact the difference between gross and net tax liabilities.

per cent a year later.

FIGURE 1: IMPORTANCE OF CORPORATION TAX REVENUES IN EXCHEQUER FUNDING



Source: Department of Finance

Growth in the importance of corporation tax revenues continued to reach an all-time high of 21 per cent in 2020. In value terms, receipts reached €11.8 billion in 2020, an increase of almost €1 billion on 2019 (McCarthy, 2021). This rapid growth and the considerable share of total revenues now coming from this single source of taxation has generated concern about the extent to which these levels can be maintained and the risks that would be associated with a slowdown in such a large component of revenues.

These concerns can be seen in several pieces of research that highlight the unexpected nature of much of this revenue growth. McGuinness and Smyth (2019) examine a range of forecasting models and show that the annual outturns of corporation tax receipts have been almost consistently higher than anticipated, outperforming one-year ahead forecasts on a regular basis. The size of the over-performance has been considerable in quantitative terms, with annual excesses in the region of €1.1 billion over five years. The unpredictability of the stream of corporation tax revenues has also been examined by the Department of Finance's (2019a) tax forecasting report, Hannon, Leahy and O'Sullivan (2015), Casey and Hannon (2016) and Conefrey, O'Reilly and Walsh (2019). This unpredictability coupled with the strong growth in its share of revenues have resulted in warnings from the Irish Fiscal Advisory Council (2019), the Central Bank (Conefrey, Hickey and Walsh, 2019) and the Department of Finance (2019b and 2020 forthcoming) that this level of revenues may be above what is sustainable in the longer run.

2.2 Calculation of Corporation Tax Liabilities

This subsection provides a brief description of the calculation of corporation tax liabilities and the steps between a company's gross trading profits and the tax that it owes on these profits. The discussion here focuses on the largest components of the corporation tax system with full details to be found on the website of the Revenue Commissioners. Recent changes of relevance to the tax code over time are highlighted in Appendix B of this paper. McCarthy (2021) gives a thorough overview of the tax returns made in 2018 and their distribution by a variety of firm characteristics which we draw on in this subsection.

The data used throughout this report come from tax returns completed by individual firms known as CT1 forms. These forms require firms to provide information on current trading income and profits, income from other sources and any deductions or credits that they are eligible to claim in order to calculate the amount of tax they owe in a given year. In 2018, the latest year for which the complete data panel was available for the purposes of this analysis, there were 168,600 CT1 returns submitted to the Revenue Commissioners. Of these, a considerable proportion (73,100 or 43 per cent) did not have any profits to report. A further 23,800 did have positive profits but did not have any corporation tax due that year reflecting their use of deductions, allowances, credits and reliefs. This left 71,700 returns with positive tax liabilities.

Table 1 shows the main components of how this calculation proceeds. The starting point is gross trading profits reported by firms operating in Ireland, which was €190,890 million in 2018. A range of deductions are then provided for in the tax code to move from gross profits to net trading income. The largest of these deductions comes from capital allowances (which amounted to just under €72,400 million).

TABLE 1: CALCULATING TOTAL CORPORATION TAX DUE

	2018 €m
Gross Trade Profits	190,889.6
Less Deductible amounts as follows:	
Trade Capital Allowances	-72,357.0
Trade Loss Forward	-13,047.8
Current Year Trading Losses	-346.4
Trade Charges	-16,390.5
Group Relief	-4,161.2
Net trading Income	84,586.8
Plus Net Foreign Dividend Income	4,451.1
Plus Net Rental Income	765.0
Plus Other Profits / Capital Gains	11,173.3
Less Total Deductions	-4,926.7
Net Taxable Income/Profits	96,049.4
Amount of Income at the 12.5% standard rate	86,898.3
Amount of Income at the 25% non-trading rate	9,151.1
Gross tax due	13,150.1
Less reliefs and credits	2,703.6
Tax Payable	10,211.2

Source: Summary of Corporation Tax Returns, Office of the Revenue Commissioners <https://www.revenue.ie/en/corporate/information-about-revenue/statistics/income-distributions/ct-calculation.aspx> Note: Additional categories are itemised in the original but omitted here for brevity.

Carrying forward previous losses can also be deducted in the calculation of net income for tax purposes, as can trade charges (payments made for the purposes of carrying on the trade or profession) and group relief (when losses can be transferred between members of a group of companies). Combined, these deductions reduce the €167 billion of gross trade profits to a net amount closer to €70 billion. Other sources of income, such as foreign dividends or rental income, are then added as also being liable to corporation tax to bring the net taxable income to just under €80 billion.

There are two main rates at which this income is then taxed. The main rate at which trading income is taxed is 12.5 per cent. There is also a higher rate of 25 per cent that applies to income from non-trading sources such as rental income. The gross tax due in 2017 was €10.5 billion with the vast majority coming from the standard rate on trading income. Gross tax due is calculated by applying the relevant tax rate to taxable income.

A number of further reliefs and credits (such as double taxation relief⁴ and a tax credit for R&D) can be applied at this stage, which reduce the total tax payable to €8.1 billion. Comparing this ultimate tax payable amount to the net taxable income

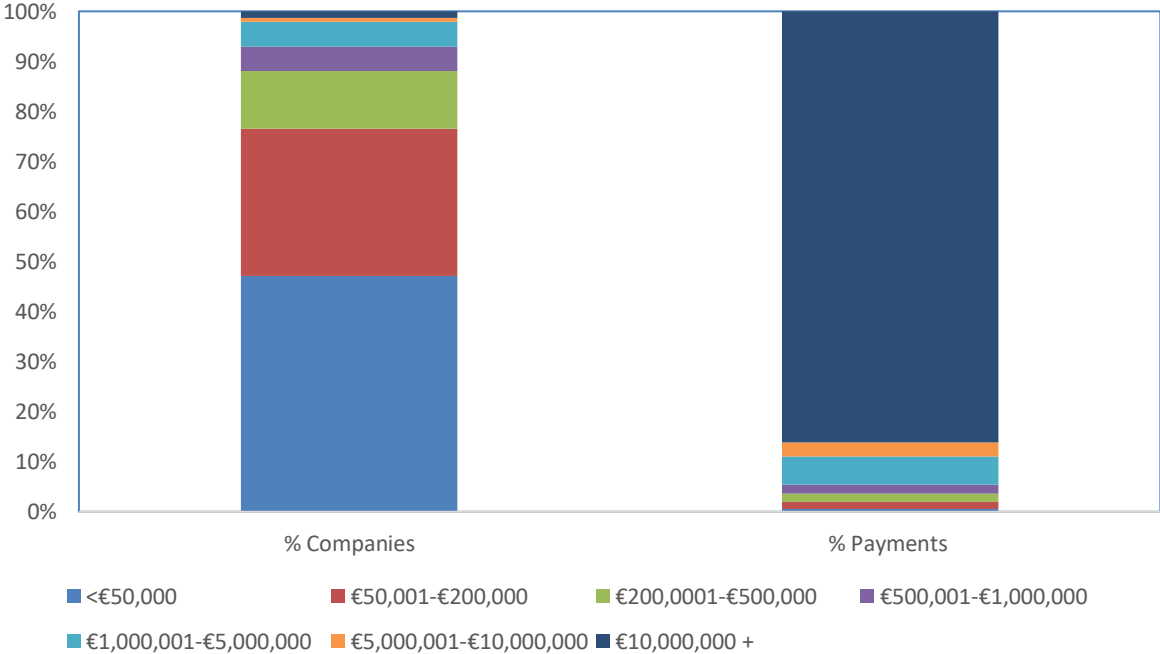
⁴ Double Taxation Relief is applied where a company is chargeable to tax in more than one country and is applied in order to avoid instances of double taxation.

gives us a simple calculation of an overall effective tax rate of 10.4 per cent, slightly under the headline statutory rate.

2.3 Distribution of Corporation Tax liabilities

While the level and growth rate of corporation tax revenues have been factors in warnings about potential risks associated with its ongoing sustainability, a further element of risk comes from the concentration of revenues. Figure 2 shows how the total number of tax cases and corporation tax revenue are distributed by ranges of net income. Of the 43,000 cases that had made corporation tax payments in 2018, just under 50 per cent were earning incomes under €50,000 and accounted for 1 per cent of tax payments made. A further 29 per cent of firms earned between €50,000 and €200,000 and these contributed 1 per cent of overall corporation tax payments. At the other end of the income size distribution, the highest earning 1 per cent of firms – those with income over €10 million – accounted for 86 per cent of actual tax payments made.

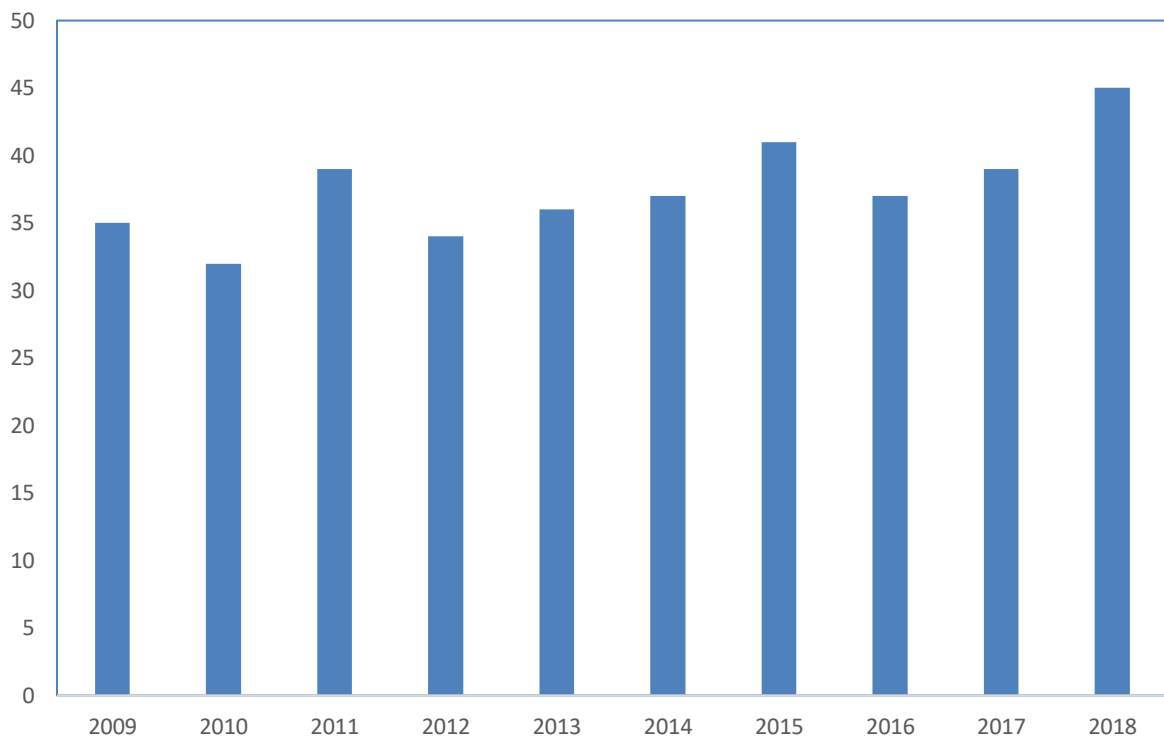
FIGURE 2: SHARE OF COMPANIES AND NET PAYMENTS BY RANGE OF NET PAYMENTS (2018)



Source: Authors calculations using CT return data

The revenues are therefore largely dependent on the top companies. Looking more closely at this end of the distribution, McCarthy (2021) shows that it is the ten largest payers that account for a substantial proportion of corporation tax revenues. The contribution of the top ten companies in each financial year is shown in Figure 3. These largest companies paid between 35 and 51 per cent of corporation tax receipts over the past ten years. However, it is important to note that the top ten are not always the same companies from one year to the next.

FIGURE 3: SHARE OF NET TAX RECIEPTS COMING FROM TOP 10 COMPANIES (%)



Source: McCarthy (2019)

In terms of ownership of the largest contributors to corporation tax revenues, McCarthy (2021) calculates that 82 per cent came from foreign-owned multinationals.

While the largest firms account for the bulk of tax revenues, by virtue of the scale and volume of their activities, they also benefit from the use of tax credits and reliefs which can reduce the gross tax due. Table 2 shows the extent to which the top 1 per cent of firms (in terms of the taxable income distribution) use the available credits and reliefs. As is the case with the examination of the tax liabilities themselves, concentration is also evident here.

TABLE 2: SHARE OF TOP 1% (P99) IN TOTAL ANNUAL VALUE OF ITEMS REDUCING THE GROSS TAX LIABILITY

	Total Reliefs	R&D Tax Credit	Other Tax Credits (Excludes R&D)
2009	85%	82%	5%
2010	87%	80%	12%
2011	83%	77%	8%
2012	84%	77%	31%
2013	85%	82%	14%
2014	90%	83%	13%
2015	92%	87%	10%
2016	92%	91%	13%
2017	94%	85%	14%
2018	95%	83%	17%

Source: Authors calculations using CT return data

3: Analytical Estimates of Corporation Tax Elasticity

3.1 Overview of Analytical Approach

The revenue elasticity for any type of tax is a measure of the extent to which tax revenue automatically responds to changes in the relevant tax base. It is a counterfactual measure which implicitly holds discretionary policy changes in the year constant. By doing so, it represents the automatic growth potential of a tax in the absence of policy change (so called 'fiscal drag'). As such, it can also be interpreted as a measure of the volatility of the tax itself (which is distinct from the volatility of the underlying tax base). Finally, the revenue elasticity is also a key component in tax revenue forecasting.

An analytical approach to constructing tax elasticities uses the insight that the overall elasticity can be expressed as the ratio of the marginal tax rate to the average tax rate (Creedy and Gemmell, 2006). This can be calculated by measuring the proportional change in tax revenue divided by the proportional change in taxable income. This is equivalent to the ratio of the marginal tax rate (MTR) to the average tax rate (ATR), where the ATR amounts to tax liabilities divided by taxable income:

$$\text{Individual revenue elasticity} = \frac{MTR}{ATR}$$

Following Acheson, Deli, Lambert and Morgenroth (2017), this report divides up the annual corporate income distribution into twenty cohorts– the first nine cohorts correspond to the first nine corporate income deciles, the tenth cohort corresponds to the 90 to 99th percentile and the eleventh to twentieth cohort corresponds to the 99th percentile divided in 10 (i.e. tenths of a per cent). This grouping is chosen given the notable concentration in Irish corporation tax receipts (McCarthy, 2021).

Following the calculation of the individual revenue elasticities for these twenty cohorts, an aggregate revenue elasticity for each year can be generated by summing the individual elasticities weighted by each cohort’s share of overall tax payable.⁵ This aggregation can be done either by assuming equi-proportional income growth or by allowing for non-equi-proportional income growth, with the latter being a more realistic description of income dynamics.⁶ We use both approaches in this section. Non-equi-proportional income growth is implemented by calculating *income* elasticities ($\theta_{Yi,Y}$) for each income cohort.⁷ Elements of the aggregate elasticity are comprised as follows:

$$\text{Aggregate revenue elasticity} = \sum_{i=1}^{20} \left(\frac{MTR_i}{ATR_i} \right) (\theta_{Yi,Y}) \left(\frac{T_i}{T} \right)$$

Where $\theta_{Yi,Y}$ refers to the cohort-level income elasticity, or, the proportional change in cohort *i*’s taxable income over the proportional change in overall net taxable income $\left(\frac{\Delta\%Y_i}{\Delta\%Y} \right)$.

Appendix C provides a worked example with an illustrative set of firms of different sizes and income growth rates to demonstrate how the aggregate analytical elasticities are calculated and to more fully explain the effects of the growth rate

⁵ The MTR and ATR are calculated as the average across all firms in the same income cohort. The tax payable share is calculated as the sum of liabilities within an income cohort divided by total liabilities across all cohorts.

⁶ An equi-proportional income growth assumption is where all firms are assumed to experience the same level of income growth in a given year. Non equi-proportional income growth allows income growth to deviate across firms.

⁷ In the baseline (assuming equi-proportional income growth), the income elasticity, $\theta_{Yi,Y}$, is assumed to be one i.e. if total net taxable income grows by 1 per cent, each cohort’s net taxable income also grows by 1 per cent. In the extended results this assumption is relaxed and the income elasticity is calculated as a ratio of the log difference in each cohort’s net taxable income to the log difference in total net taxable income. This calculation is the only exception to the principle of constructing the analytical elasticity using in-year data (the log difference is taken over two years).

assumptions.

Before undertaking any calculations, our expectation would be that the elasticity for corporation tax should be above 1, as typically the ATR would be less than the MTR given that elements of the tax code such as reliefs and credits can be used to reduce gross tax due.

This approach to the calculation of elasticities using micro data has been applied to a number of different taxes including to the estimation of the responsiveness of the UK corporation tax system by Creedy and Gemmell (2002, 2004, 2006, 2008). The method has also been applied to Ireland for the analysis of income tax revenue elasticities (Acheson, Deli, Lambert and Morgenroth, 2017) and of VAT revenue elasticities (Acheson, Deli, Lambert, Morgenroth and Murphy, 2018).

In applying this analytical approach to corporation tax returns, the marginal tax rate is taken to be the statutory rate of 12.5 per cent for firms with trading income only. Where firms also have income from non-trading sources that would be liable for the higher rate of 25 per cent, this is used as the relevant marginal tax rate if over half of their taxable income is liable at this rate.⁸ This assumption results in 29 per cent of taxpayers being assigned 25 per cent as their marginal tax rate in this analysis. However, as taxpayers who are subject to a 25 per cent rate account for just 5 per cent of total taxable income (see Table 1), whilst a relatively high proportion are assigned a rate of 25 per cent marginal rate, their actual tax payable is relatively low.

3.2 Analytical Results - baseline

Table 4A presents the estimates for the annual aggregate revenue elasticities under the baseline assumption that all firms experience the same income growth in a given year (equi-proportional income growth). Taking 2009 as an example, the table is read as follows: for every one percent increase in the tax base (net taxable income), corporation tax payable increase by 1.25 per cent. The figures in Table 4A suggest that the tax elasticity has gradually trended up over time, standing at 1.34 for the latest year available (2018). In 2014, the elasticity is unusually high; this is due to an atypically low ATR for the highest income group that year (8.3 per cent in 2014 as opposed to 9.8 per cent for the period as a whole). Taking an average of the annual estimates over the period 2009 to 2018, the aggregate elasticity is 1.3.

The annual estimate of tax buoyancy by year in Table 4B, which is constructed as

⁸ Because of the way the data is structured, it is not possible to obtain tax payable resulting directly from the 25% CT rate separately from other liabilities resulting from the 12.5% CT rate.

the ratio of the log growth rate in observed aggregate liabilities to the log growth rate in the overall tax base, is considerably more volatile than the tax elasticity.⁹ The average of these annual estimates is 0.9 over the period 2009 to 2018. In almost all years, the estimate for the tax elasticity exceeds the estimate of tax buoyancy, which may be interpreted in the literature to mean that, all else equal, discretionary policy over the period has been relatively revenue-reducing. This is entirely expected in this context as the discretionary policies in question primarily relate to tax credits and reliefs, which mechanically result in reductions in gross tax due.

TABLE 4A: AGGREGATE REVENUE ELASTICITIES BY YEAR (BASELINE)

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.25	1.25	1.27	1.30	1.28	1.41	1.28	1.30	1.32	1.34

Source: Authors calculations using CT return data

TABLE 4B: AGGREGATE TAX BUOYANCY BY YEAR

2010	2011	2012	2013	2014	2015	2016	2017	2018
0.61	-0.13	0.64	1.00	0.83	0.96	1.44	1.14	1.22

Source: Authors calculations using CT return data.

3.3 Analytical Results – Non equi-proportional growth

The assumption in the baseline calculations that net taxable income growth is uniform across the income distribution is unlikely to hold in reality. We therefore relax that assumption in this section and calculate the elasticities while allowing net taxable incomes to grow at different observed rates. Table 5 shows the elasticity results in this case.

TABLE 5: AGGREGATE REVENUE ELASTITIES BY YEAR (NOT ASSUMING EQUI-PROPORTIONAL INCOME GROWTH)

2010	2011	2012	2013	2014	2015	2016	2017	2018
1.25	1.23	1.31	1.20	1.42	1.27	1.29	1.33	1.42

Source: Authors calculations using CT return data

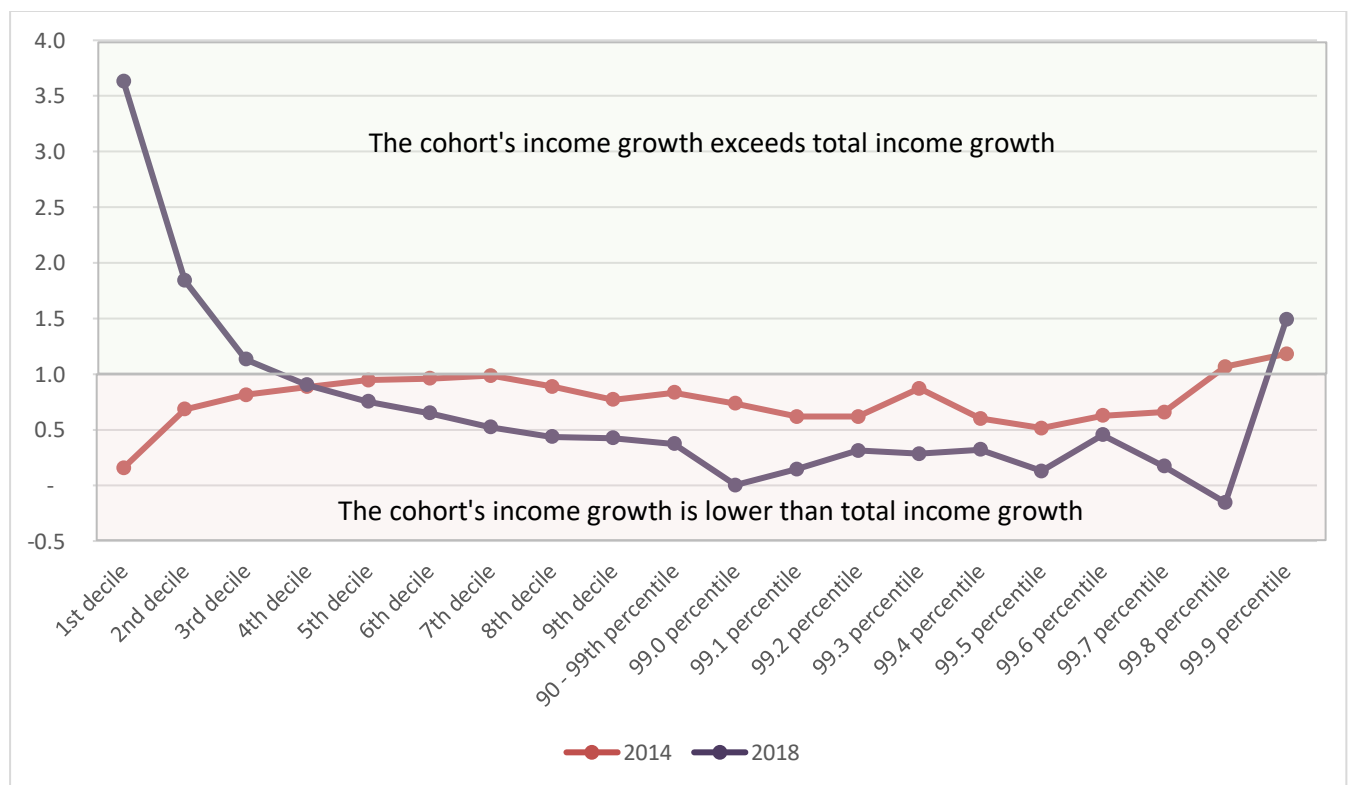
They do not differ too much from the baseline results in Table 4. Taking an average of the annual estimates, the aggregate revenue elasticity for the period is 1.3, as was the case in the baseline results. One explanation for this is that, while the income growth of the highest income cohort (the 99.9th percentile) always exceeds total income growth, this effect is counteracted by the relatively slower income

⁹ A comparison of the tax elasticity and tax buoyancy is most appropriate, as both are constructed analytically.

growth of the 90th to the 99.8th percentiles. Since 2011, the 99.9th percentile of the distribution has accounted for at least half of total net taxable income, while much of the remaining tax base is accounted for by the 90th to 90.8th percentile. Given these weights, their often-opposing income dynamics appear to cancel each other out in construction of the aggregate revenue elasticity.

Figure 7 demonstrates how taxable income grows at different rates across the income distribution. It also highlights how income growth rates may differ considerably across years for the same income cohort. Using the ninth decile in 2018 as an example, each point on the graph can be read as follows: for a one per cent increase in total net taxable income in 2018, net taxable income for the ninth decile increased by 0.4 per cent. By contrast, for a one per cent increase in total taxable income in 2014, net taxable income for the ninth decile increased by 0.8 per cent.

FIGURE 4: COMPARISON OF INCOME ELASTICITIES ACROSS INCOME DISTRIBUTION



Source: Authors calculations using CT return data

The key insight of the results of this section is that while income dynamics, particularly for the largest taxpayers, were a priori expected to influence the revenue elasticity, this does not turn out to be the case. Although there are considerable differences in income growth across the income distribution, this has

a minimal impact on the *aggregate* revenue elasticity estimate, reflecting the negligible differences in the (non) / equi-proportional income assumptions. This result is potentially important in that it suggests the strong income growth performance of the largest taxpayers, which are significant given the well-flagged concentration of CT, has little bearing on fiscal drag for this tax head.

4: Discussion and Conclusions

Corporate tax receipts make up a sizeable and growing share of government revenues in Ireland. This has led to concerns about the sustainability of the overall revenues and risks around the concentration of the tax base. Against this background, this report provides one of the most detailed investigations to date into the structure of net taxable income and corporation tax payable using a unique and comprehensive data set compiled from individual tax returns. This allows us to estimate how tax payable react to changes in net taxable income

Our focus is on how tax payable relates to the tax base. It is important to emphasise therefore that the tax base used is the net taxable income of the firms and not gross trade profits. This means that allowances or deductions that are applied to reduce the level of profits liable for tax are excluded from the elasticity calculations.

We use an analytical approach to estimate tax elasticity, which is one method to links the firm's corporation tax payable to their net taxable income. The elasticity of a tax measures the responsiveness of tax revenue to changes in the tax base, keeping all other parameters constant. It therefore indicates the built-in 'fiscal drag' properties of the corporation tax system and is also the relevant measure for tax forecasting.¹⁰

Our baseline estimate for the aggregate tax revenue elasticity is 1.3. This implies that for every 1 per cent increase in the tax base, tax payable automatically increase by 1.3 per cent. Looked at on an annual basis, we find a slight upward trend over time with the elasticity increasing from 1.25 per cent in 2009 to 1.34 in 2018. This suggests that the built-in 'fiscal drag' properties of the corporation tax system have slightly increased over time. Discretionary policy changes play no part in the interpretation of the tax revenue elasticity as they are held constant by definition.

We also find that there are considerable differences in income growth across the

¹⁰ As noted earlier, this is related to is the concept of tax buoyancy which measures the total response of tax revenue to both changes in the tax base and to discretionary policy changes over time. We focus only on the elasticity concept in this paper.

income distribution, but that this has a minimal impact on the revenue elasticity estimate. This result is potentially important in that it suggests the strong income growth performance of the largest taxpayers, which are significant given the well-flagged concentration of CT, has little bearing on the estimated fiscal drag for this tax head.

Overall, this tax elasticity analysis points to different patterns for the largest firms and largest taxpayers being an important feature in understanding the responsiveness of tax payable to net taxable income. The analysis presented in the report offers new insights both for assessing the risks associated with corporation tax and for improving the approach to forecasting this tax head.

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Appendix A: Data definitions

TABLE A1: DESCRIPTION OF TAX VARIABLES

Variable Name	Variable Description
Gross trade profits	Gross Trade Profits after wages and expenses before Capital Allowances (these are profits taxed at 12.5%)
Taxable income	Total income less reliefs etc., i.e. income that's subject to taxation at different rates (25%, 12.5% etc)
Tax payable	Total Corporation tax firms are liable to pay. Note the tax liability figure is based on a tax year.
Current year trading losses used	The amount of current year loss claims actually used in the year to offset against tax payable
Trade loss forward used	The amount of carried forward loss claims that have actually been used to offset against tax payable. May include unused capital allowances as well as historical losses.
M&P allowances claimed	Machinery and Plant (MP) Capital Allowances claimed (including motor vehicles), includes intangible assets
Trade capital allowances used	The amount of Capital allowance claims actually used in the year. This includes both tangible and intangible allowances (they are not available disaggregated)
Intangible allowances claimed	The amount of intangible assets claimed against tax. This is a subcomponent of the Machinery & plant allowances figure. Enters as a claim rather than used.
R&D credit used	The amount of R&D credit claims that have actually been used to reduce CT liability in the year
R&D refund	When CT liability is lower than the R&D tax credit, the firm is entitled to a proportion of this figure as a refund.
Total reliefs used	The amount of relief claims that have actually been used against CT liability. Summation of the double taxation relief, relief for other trading deductions, relief for manufacturing trade deductions, other manufacturing relief, other tax reliefs, additional foreign credit and the relief for certain start-up companies.
Total credits (excluding R&D) used	Credits used against CT liability. Summation of the film credit, Income tax suffered credit and the gross withholding tax on fees. It excludes the R&D Credit.
Trade charges used	The amount of trade charge claims that have actually been used in the year. Trade charge is a payment made entirely for the purpose of a profession or trade. Under certain conditions relief is provided.
Group relief used	The amount of group relief claims that have actually been used in the year against trading income
Sec.247 loan relief used	The amount of Sec.247 loan relief claims that have actually been used in the year. This is relief provided for interest on certain loans that has been used to reduce overall CT liability.

Appendix B: Examples of tax code changes, 2008-2017

Directly impacts tax base	Directly impacts tax liability
<ul style="list-style-type: none"> • Budget 2009 – Abolition of special 20% rate applied to the trading profits from dealing in or developing residential development land. • Introduction of Section 291A – 80% cap on amount of capital allowances for intangible assets deductible from trading income arising from those assets (from 7 May 2009). • Finance Act 2014 – increase in Section 291A cap on proportion of intangible allowances deductible from trading income to 100% (for accounting periods commencing 01/2015) • Finance Act 2014 – removal of requirement to take account of base year expenditure when calculating R&D expenditure • Finance Act 2015 – amendment to section 765 (capital allowances for expenditure on scientific research) to ensure capital allowances cannot be made in respect of the same expenditure under any other tax provision and to ensure that the asset in question must be brought into use by the beneficiary to qualify. • Finance Act 2015 – Introduction of KDB - profits from patented inventions and copyrighted software (qualifying assets) earned by an Irish company can, to the 	<ul style="list-style-type: none"> • Budget 2008 - Preliminary Tax payment arrangements for Start-up Companies – increase in tax liability threshold to €200,000 for payment dates arising after 5 December 2007. • Finance (No. 2) Act 2008 - introduction of ‘repayable credit’ in respect of the R&D tax credit. • Budget 2012 - 3 Year Tax Relief for Start-up Companies. • Finance Act 2012 – qualifying R&D expenditure cap set to €100k and the introduction of the key employee relief provision for the R&D tax credit. • Finance Act 2013 - qualifying R&D expenditure cap raised to €200k. • Budget 2009 - Preliminary Tax payments requirement.

<p>extent it relates to Research and Development (R&D) undertaken by that company, be effectively taxed at a rate of 6.25 per cent.</p> <ul style="list-style-type: none"> • Finance Act 2017 - implementation of Coffey Review of Corporation Tax Code. 2017 - section 291A 100% cap reduced back down to 80% (in respect of claims relating to capital allowances incurred on or after 11/09/2017). <p>Transparency-enhancing measures:</p> <ul style="list-style-type: none"> • 2012 signature of FATCA Agreement with USA. • Implementation of DAC3 automatic exchange of information (EOI) on cross-border tax rulings. • Introduction of CbCR reporting (Finance Act 2015) Subsequent agreement of DAC4 Directive. <p>2016/2017 - agreement of ATAD (anti-tax avoidance directives) with other EU Member States. These include:</p> <ul style="list-style-type: none"> • Controlled foreign company rule, switchover rule, exit-taxation, interest limitation and the general anti-abuse rule 	
<ul style="list-style-type: none"> • 2013 changes to residency rules (Finance (no. 2) Act 2013 and closure of the Double Irish (Finance Act 2014) – both direct liability and base impacts 	

APPENDIX C: Estimation of analytical corporation tax elasticities

The example below applies an illustrative worked example of how the aggregate analytical elasticities reported in Section 3 are calculated.

Individual revenue elasticity

Individual revenue elasticity for a firm with net taxable income of €30,000 and tax payable of €3,000 paying 12.5% corporation tax:

$$\begin{aligned} \text{Individual firm revenue elasticity} &= \frac{MTR}{ATR} = \frac{\text{statutory rate}}{\frac{\text{tax liability}}{\text{taxable income}}} \text{ and } ATR = \frac{\text{tax liability}}{\text{taxable income}} \\ &= \frac{0.125}{\frac{3000}{30000}} = 1.25 \end{aligned}$$

Elasticity interpretation: When the firm's net taxable income increases by 1%, tax revenue increases by 1.25%

Aggregate revenue elasticity

Simply averaging individually estimated firm-level elasticities such as this is problematic in that a simple average of such values in a given year would underrepresent the relatively small number of firms who have the highest net taxable incomes. To address this issue, firms are grouped by net taxable income brackets (20 in this case). A revenue elasticity is estimated for each cohort, then multiplied by the income elasticity ($\theta_{Yi,Y}$), and this in turn is then weighted by each cohort's respective share in total tax payable $\left(\frac{Ti}{T}\right)$.

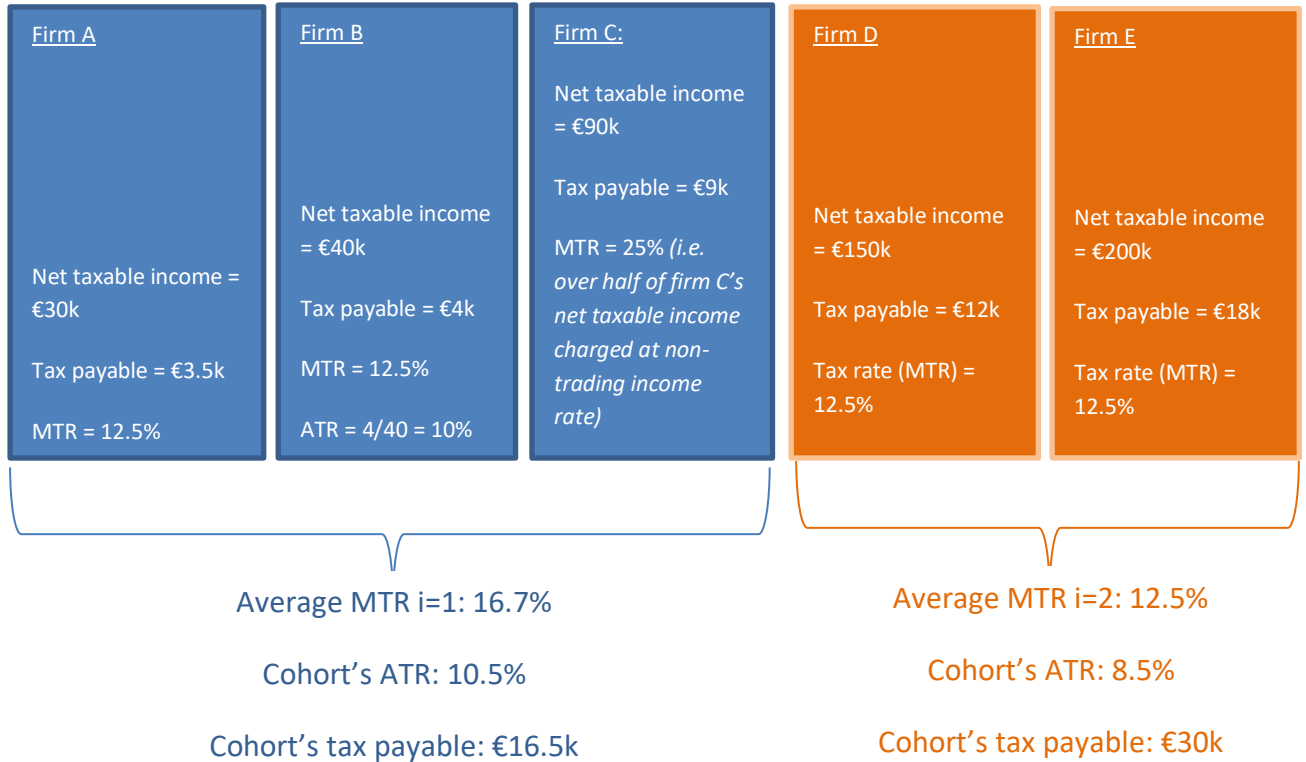
$$\text{Aggregate group revenue elasticity} = \sum_{i=1}^{20} \left(\frac{MTR_i}{ATR_i} \right) (\theta_{Yi,Y}) \left(\frac{Ti}{T} \right)$$

Here $\theta_{Yi,Y}$ refers to the cohort level **income** elasticity. This amounts to the proportional change in cohort i 's net taxable income over the proportional change in overall net taxable income $\left(\frac{\Delta\%Y_i}{\Delta\%Y}\right)$.

If we assume that all cohorts' aggregated net taxable incomes grow at the same rate as total net taxable income between one year and the next (referred to above as equi-proportional income growth), then the cohort's income elasticity ($\theta_{Yi,Y}$) equals 1, and becomes redundant. If we relax this assumption and assume more plausibly that cohorts' net taxable income growths are not identical to total net taxable income growth (non equi-proportional income growth), the difference is captured by $\theta_{Yi,Y}$.

Illustrative example:

Suppose there are 2 cohorts of firms in the economy: Cohort 1: each with net taxable income falling in the range of 0-€100k, Cohort 2: with net taxable income in the range of €100k-€200k. For ease of illustration assume there are 3 firms in group 1 and 2 firms in group 2



Total tax payable: €46.5k

Cohort 1's MTR is above the statutory rate on account of Firm C's higher rate applied to non-trading profits.

Under an assumption of equi-proportional growth: cohorts 1 and 2 experience net taxable incomes growth rates equivalent to total net taxable income growth rate ($\theta_{Y_i,Y} = 1$)

$$\begin{aligned}
 \text{Aggregate revenue elasticity} &= \sum_{i=1}^2 \left(\frac{MTR_i}{ATR_i} \right) (\theta_{Y_i,Y}) \left(\frac{T_i}{T} \right) \\
 &= \frac{MTR_1}{ATR_1} (\theta_{Y_1,Y}) \left(\frac{T_1}{T} \right) + \frac{MTR_2}{ATR_2} (\theta_{Y_2,Y}) \left(\frac{T_2}{T} \right) \\
 &= \frac{0.167}{0.105} \cdot (1) \cdot \left(\frac{16.5}{46.5} \right) + \frac{0.125}{0.085} \cdot (1) \cdot \left(\frac{30}{46.5} \right) = 1.5
 \end{aligned}$$

Elasticity interpretation: When net total taxable income increases by 1%, total tax revenue increases by 1.5%

Under an assumption of non equi-proportional growth: cohorts 1 and 2 experience net taxable incomes growth rates that differ from the total net taxable income growth rate ($\theta_{Y_i,Y} \neq 1$)

Group 1: Firm A's net taxable income has grown to €35k (by €5k or 16.7%) between t and $t + 1$. Net taxable incomes of B and C have not grown in this period. This represents a 3.1% increase in cohort 1's overall net taxable income

Group 2: Firm C's net taxable income has grown to €170k (by €20k or 13%) and firm D has grown to €230k (by €30k or 15%) between t and $t + 1$. This represents a 14.2% increase in cohort 2's overall net taxable income

Total net taxable income (cohorts 1 + 2) has increased by €55k or by 10.8% in the period

Thus, the unique group income elasticities are:

Cohort 1: $\theta_{Y_1,Y} = \frac{3.1}{10.8} = 0.28$

Cohort 2: $\theta_{Y_2,Y} = \frac{14.2}{10.8} = 1.31$

$$\begin{aligned} \text{Aggregate revenue elasticity} &= \sum_{i=1}^2 \left(\frac{MTR_i}{ATR_i} \right) (\theta_{Y_i,Y}) \left(\frac{T_i}{T} \right) \\ &= \frac{MTR_1}{ATR_1} (\theta_{Y_1,Y}) \left(\frac{T_1}{T} \right) + \frac{MTR_2}{ATR_2} (\theta_{Y_2,Y}) \left(\frac{T_2}{T} \right) \\ &= \frac{0.167}{0.105} \cdot (0.28) \cdot \left(\frac{16.5}{46.5} \right) + \frac{0.125}{0.085} \cdot (1.31) \cdot \left(\frac{30}{46.5} \right) = \mathbf{1.4} \end{aligned}$$

Elasticity interpretation: When total net taxable income increases by 1%, total tax revenue increases by 1.4%.

Each individual year's analytical elasticity is derived on the above basis. The respective estimation procedures are re-applied in-full for each year shown in Tables 4a and 5, such that the income groupings, the weights, the revenue elasticity (MTR/ATR) and income elasticity are re-estimated each year.