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VAT revenue elasticities: An analytical approach

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Working Paper No. 596

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Revised

VAT revenue elasticities: an analytical approach

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Derek Lambert^d and Martin Murphy^e*

Abstract: *In this paper we construct analytical estimates of the elasticity of VAT revenues with respect to underlying gross income and expenditure for Ireland. The responsiveness of VAT revenue from households in Ireland to changes in household gross income steadily increased up to the late 2000s. The introduction of the income levy and the doubling of the health levy resulted in a reduction in the VAT elasticity, as higher income tax rates also reduced disposable incomes. This spill-over effect highlights the importance of judging the broader implications of tax policy. It also suggests that policymakers during any subsequent fiscal crisis should be cautious when choosing the composition of tax adjustments, as there is a clear trade-off to be made. The VAT revenue elasticity is lower for Ireland than estimates for the UK, New Zealand and Australia, possibly reflecting the greater progressivity of the Irish income tax system compared to other OECD countries.*

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VAT revenue elasticities: an analytical approach

Abstract: In this paper we construct analytical estimates of the elasticity of VAT revenues with respect to underlying gross income and expenditure for Ireland. The responsiveness of VAT revenue from households in Ireland to changes in household gross income steadily increased up to the late 2000s. The introduction of the income levy and the doubling of the health levy resulted in a reduction in the VAT elasticity, as higher income tax rates also reduced disposable incomes. This spill-over effect highlights the importance of judging the broader implications of tax policy. It also suggests that policymakers during any subsequent fiscal crisis should be cautious when choosing the composition of tax adjustments, as there is a clear trade-off to be made. The VAT revenue elasticity is lower for Ireland than estimates for the UK, New Zealand and Australia, possibly reflecting the greater progressivity of the Irish income tax system compared to other OECD countries.

I. Introduction

Value added tax (VAT) is applied in many countries¹, and in those it typically accounts for a significant share of total tax revenue. For example, in the EU the average tax revenue raised through VAT equates to 7% of GDP and 17.5% of total tax revenue. However, there is significant variation in this, with VAT accounting for just 14.2% of tax revenues in Italy while it accounted for 34.3% in Croatia in 2016². This reflects not only differences in VAT rates, which average 21.5% and range between 17% (Luxembourg) and 27% (Hungary), but also depends on expenditure patterns. Given the significance of VAT as a source of tax revenue it is important to understand the relationship between VAT revenue and underlying activity, which is measured by the VAT elasticity. Accurate estimates of this elasticity will help in tax forecasting.

Value Added Tax (VAT) revenues typically make up just over a quarter of Exchequer receipts in Ireland. It is currently the second largest revenue-raiser after income tax and was the largest prior to the recession. As such fluctuations in VAT revenue have a high automatic impact on total tax revenue. The purpose of this study is to estimate the elasticity of VAT tax revenues in the Irish economy. The size of the VAT elasticity is of importance for forecasting reasons and it is notable that VAT revenues fell more in Ireland compared to the rest of the tax revenues during the recession.

In this paper we construct analytical estimates of the elasticity of VAT revenues with respect to underlying gross income and expenditure. To do so we will build on the analysis of Acheson

¹ Exceptions include a number of oil producing countries (e.g. Saudi Arabia, UAE), special status territories (e.g. Hong Kong, Gibraltar) or tax havens (e.g. Bermuda, Cayman Islands). While the USA does not have a value added tax, some individual US states operate a sales tax.

² Source: Eurostat Government Finance Statistics

et al. (2017) on income tax revenue elasticities, by applying a similar methodology to VAT. This approach allows us to reflect the structure of the VAT system as well as income taxes, which are important in determining the households' disposable income. Given that the purchase of new houses has been such an important influence on VAT receipts in Ireland in the past, we also examine the impact of changes in the housing market on VAT revenues.

The elasticities are constructed using budget shares for goods commanding different VAT rates, estimated at different points on the income distribution. Thus, changes of the elasticities are a function of expenditure pattern changes, savings behaviour and fiscal changes (in income tax or VAT). More specifically, following Creedy and Gemmell (2007) we consider several responses when constructing VAT revenue elasticities: (i) changes in disposable income (affected by income tax changes); (ii) changes in total expenditure (if saving behaviour changes); and (iii) changes in tax-liable expenditure shares (for example, if expenditure patterns change towards, or away from, VAT-taxed goods). Only after these responses have been modelled or estimated can information on VAT tax structures be applied to generate the automatic change in VAT revenues arising from a change in either gross income or a change in expenditure. The analysis reveals that changes in the income tax system have been more influential than any other changes.

For the estimation, either expenditure or tax-liable expenditure could be used as a tax base. In this paper, we look at expenditure rather than only tax-liable expenditure to fully account for changing expenditure patterns (including switching to or from VAT-liable goods and services). We use data of household expenditure from five successive waves of the Household Budget Survey (HBS from now on), a nationally representative survey of private households that documents household expenditure HBS surveys have been carried out periodically in Ireland since 1951. The time period covered by this paper is 1994/95 to 2015/16.

Given the data source, we restrict ourselves to the household sector. Other actors in the economy also pay VAT (e.g. firms) but they are outside the scope of this research. Households are typically responsible for roughly two-thirds of all VAT receipts (European Commission, 2017) and it is largely the consumer's basket which is affected by the VAT rate changes. Importantly, the HBS does not provide information on the date and value of house purchases so VAT arising from the purchase of new houses is also excluded from the analysis. We expect that this provides more clear results, which are less affected by the housing-bubble and provide a more intuitive analysis of the VAT elasticity as an automatic stabiliser of the economy.

VAT revenues can exhibit low volatility over the economic cycle since personal consumption expenditure (PCE), which is the main component of VAT receipts, is a relatively stable component of GDP (i.e. households engage in consumption smoothing). However, consumption smoothing mechanisms could fail if an economic slowdown is prolonged or households' access to credit is restricted. VAT receipts may also be volatile due to other components of the VAT base, such as gross investment, which is far more sensitive to the economic cycle.

In Ireland's case, VAT revenues are pro-cyclical to consumption expenditure. However, the fact that VAT receipts contracted relatively more severely than personal consumption expenditure during the recession highlights an important feature of Irish VAT, which is the contribution of the housing sector to VAT revenues. The Department of Finance estimates that the proportion of VAT arising solely from the purchase of new houses in the 2000s was over 10 percent on average, with this proportion dropping sharply in subsequent years.³ This feature of Irish VAT also explains why receipts have not returned to their pre-crisis levels, in line with GDP over the recovery years.

VAT revenues are likely to be income-inelastic from the perspective of households (i.e. VAT revenues increase by proportionally less than an increase in gross income) due to the impact of the income tax system and savings choices. This is in contrast to income tax revenue elasticities, where revenues typically increase by proportionally more than an increase in income for progressive income tax systems (see Acheson *et al.* (2017) for further detail).

In this paper we find that the responsiveness of household VAT revenues to changes in household gross income steadily increased up to the late 2000s as marginal income tax rates fell, leaving households with higher post-tax incomes. However, the introduction of the income levy and the doubling of the health levy in 2009, caused a notable decline in the automatic responsiveness of VAT revenues to income growth, as higher income tax rates also had the effect of reducing on the margin the resources available to be taxed via indirect taxes. This spill-over effect highlights the importance of judging tax policy in the round and not at the level of one individual tax head. It also suggests that policymakers during any subsequent fiscal crisis should be cautious when choosing the composition of tax adjustments, as there is a clear trade-off to be made.

Given the definition of the VAT elasticity we expect that the estimates of the responsiveness of VAT revenues to changes in household expenditure are higher, reflecting the fact that VAT revenues will be more responsive to direct changes in its base rather than to a variable that only partially determines the base (gross income). This is the case in Ireland. However, we find that for Ireland, this elasticity is notably lower in the 2000s compared to the 1990s, and the change reflects two developments. In particular, we find that the switch from a tax-free allowance to a tax credit-based income tax system in 2001 led to a sharp decrease in average tax rates and an increase in the progressivity of the income tax system. This change appears to have had a knock-on effect on VAT elasticities. In addition, increased household savings ratios from the 1990s into the 2000s also reduced the elasticity. This result highlights a behavioural change in taxpayers, who may have been influenced by the income tax system (where marginal tax rates fell over time) and who may also have formed more pessimistic expectations for the economic recovery in the latest years of our study.

We observe that expenditure patterns have also changed over the 1990s and 2000s, as households increased their spending on VAT-exempt goods and services (in particular housing costs such as mortgage repayments and rent). Typically, rising disposable incomes

³ Note the Department makes the early 2000s calculation using average new house prices and the volume of transactions. For 2010 onward, the CSO Residential Property Price Index (RPPI) series covering the value of transactions by stamp duty event, across all buyer types for new dwellings, is applied.

are associated with an increasing expenditure share devoted to standard-rated goods (i.e. non-essential items). However, as Ireland's VAT code exempts housing costs (apart from new home purchases) this reduces the elasticities, though surprisingly this had a weaker impact on the VAT elasticity than changes in the income tax system.

When it comes to comparing the Irish VAT elasticity to that of other countries, we find that it is lower than estimates for the UK, New Zealand and Australia, possibly reflecting the greater progressivity of the Irish income tax system compared to other OECD countries (as its progressivity implies less household resources at the margin available for expenditure). This result is in line with the one of Acheson *et al.* (2017) who find that the Irish income tax system is highly progressive compared to the aforementioned countries. We suggest that as the VAT elasticity is affected by income, the more progressive the income tax system the less progressive the VAT elasticity.

The rest of the paper proceeds as follows. Section 2 provides a brief history of the VAT system and the trends of the basic factors affecting it. Section 2 describes the methodology and the data used to estimate the VAT revenue elasticity. Section 4 discusses the results. Finally, Section 5 concludes and discusses the policy implications.

II. Trends and factors affecting VAT

VAT revenues are affected by several factors. They are directly affected by the VAT tax rates, consumption expenditure, income, and savings. However, they are also indirectly affected by factors like other types of taxation, which in turn affect disposable income, the level of wages, inflation, house prices, and the housing and mortgage market in general. Finally, we also expect that VAT revenues depend on the size of the black economy in a country. In this section, we provide an analysis of the trends of some of those basic factors affecting VAT revenues, which will enable us to more easily understand the results arising from our analytical estimations.

2.1. VAT in Ireland and in the rest of the world

Before proceeding in the more detailed analysis of the trends affecting VAT revenues and to the estimation of the VAT elasticity, we briefly describe the Irish VAT system and compare it with that of other countries.

Ireland adopted VAT in 1971 in preparation for joining the European Economic Community (EEC) in 1973. It replaced two pre-existing turnover taxes in Ireland. All EU member states broadly align their rules for VAT within an agreed legal framework – mainly the EU VAT Directive (2006/112/EC) - that sets out minimum and maximum rates. Like most countries, Ireland exempts financial intermediation services like banking from VAT due to the practical difficulties of administering the tax in this area. It also exempts other goods and services for social reasons, for example funeral undertaking and health services.

Ireland has five positive VAT rates, although only the three levied on the household sector are of concern here. The main zero-rated items are food, oral medicines, books and children's clothes and footwear. A reduced rate of 9% (in 2018) primarily applies to labour-intensive and

tourism-facing sectors such as restaurants, hotels and various entertainment services. A rate of 13.5% (in 2018) applies to fuel used for heating and lighting, new houses, construction and general repairs. To account for the fact that many farmers are not registered for VAT and therefore cannot reclaim VAT paid, a special arrangement is in place where farmers can charge VAT registered customers who can claim VAT back at a rate of 5.4% and 4.8% for livestock. All other items bear a rate of 23 percent (in 2018).

The Irish VAT system is thus highly non-uniform, in fact more so than most EU states with the exception of the UK. Large components of domestic consumption are exempt and there is more than one positive rate. This design is historical in nature, reflecting that the turnover taxes, which were replaced by VAT were also highly non-uniform, but also reflects distributional objectives. Nevertheless, VAT is found to be regressive with respect to the income distribution and roughly proportional with respect to the expenditure distribution.

The Irish VAT system has seen very few changes for households in the period under review. The only major change of note was the introduction of the 9% reduced rate in mid-2011 (reduced from 13.5% for the majority of the goods and services in question)⁴. The income tax system, by contrast, has changed considerably over the period: it has become more progressive and marginal tax rates have fallen at all points on the income distribution. The income levy was introduced as an additional tax on income in 2009 and the Universal Social Charge (USC) replaced both this and the health levy in 2011.

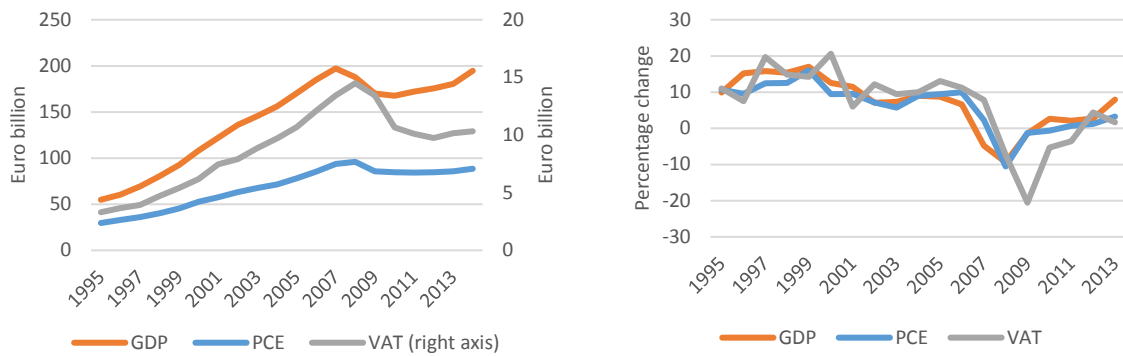
From an international aspect, while VAT is applied in many countries, it is not universally applied. Main VAT rates across the EU range between 17% (Luxembourg) and 27% (Hungary) and averages 21.5%. Most EU countries also have reduced rates of VAT, often as low as 5%, and some exemptions. Apart from heterogeneity with respect to VAT rates, there is also a significant difference in the importance of VAT as a source of revenue. For the EU the average tax revenue raised through VAT equates to 7% of GDP and 17.5% of total tax revenue. Again, there is significant variation with VAT accounting for just 14.2% of tax revenues in Italy while it accounted for 34.3% in Croatia in 2016.

2.2 Savings and disposable income

As already discussed, in Ireland VAT revenues are pro-cyclical with respect to consumption expenditure. This can be seen in Figure 1 where in part (b) we observe that the trend of the VAT revenues follows the fluctuations of both GDP growth and Personal Consumption Expenditure (PCE).

⁴ There have been various VAT changes for farmers, but these are outside the scope of this paper.

Figure 1: VAT revenue and personal consumption expenditure
(a) nominal values **(b) annual nominal growth rates**

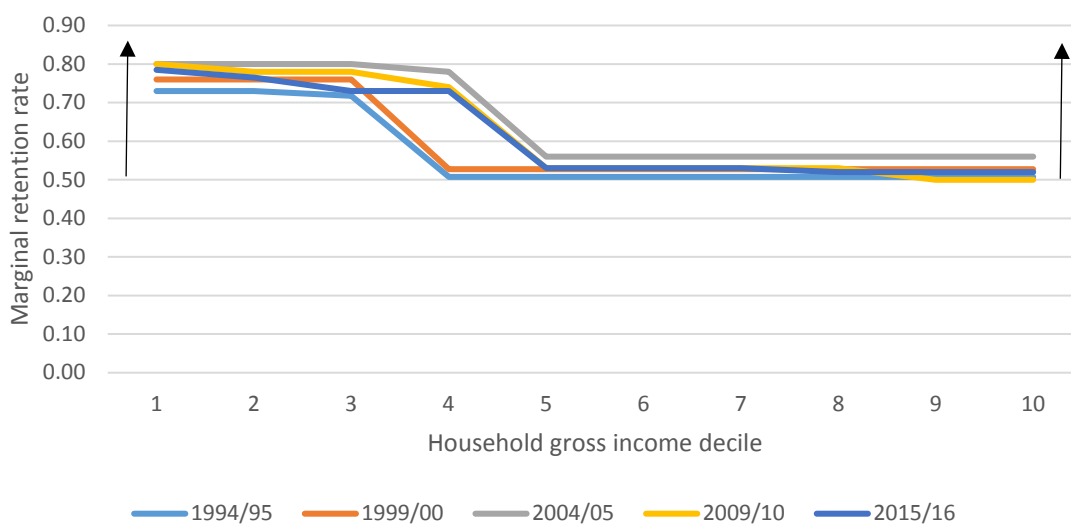


Source: Department of Finance and CSO

When it comes to understanding expenditure patterns and how these affect VAT revenues, it is useful to first consider disposable income, which in turn is a function of income tax. The marginal income tax rate determines how much of each additional euro of gross income is taxed. The marginal retention rate, which equals 1 minus the marginal tax rate, will therefore indicate how much of each additional euro of gross income is retained as disposable income.

During the 1990s and 2000s, marginal tax rates fell in Ireland. Figure 2 shows this effect for the Single category taxpayer. In all income deciles marginal tax rates fell, meaning that marginal retention rates, and therefore disposable income on the margin, increased over time. However, by 2015/16, the marginal retention rate was higher at all points on the income distribution compared to 1994/95., but the peak occurred in 2004/05 i.e. prior to the fiscal crisis and recession.

Figure 2: Marginal retention rate for income tax, single taxpayer category



Source: Household Budget Survey

Note: the method by which households are designated as Single category income taxpayers is outlined fully in the Methodology section below.

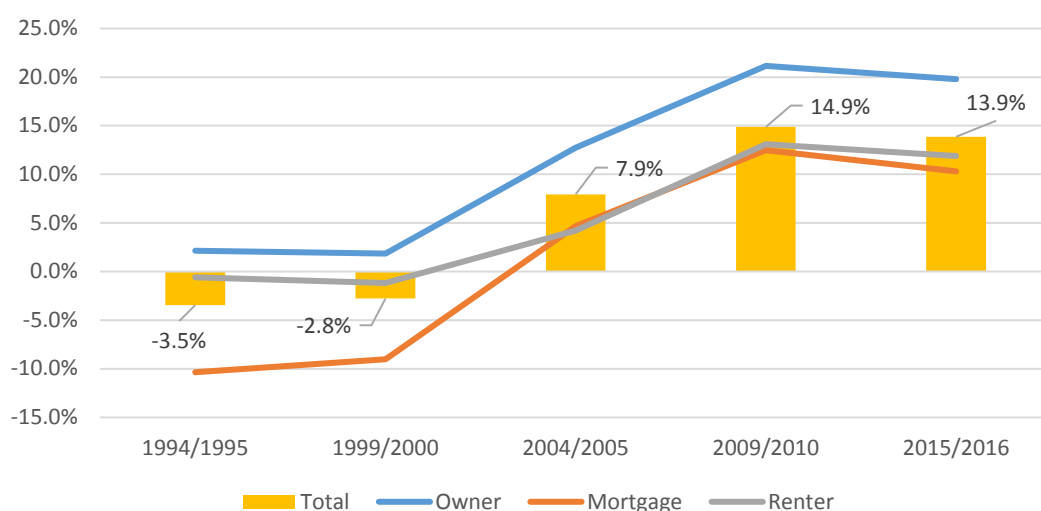
As household disposable income increases due to, amongst other factors, discretionary income tax policy changes, households need to choose how to allocate additional disposable income between expenditure and savings. The HBS data allow us to examine this allocation and to see whether it has changed across time. Figure 3 shows the median savings ratio for all households (yellow bars) and also for different household categories. The savings ratio is one minus the ratio of expenditure to disposable income.⁵

As our definition of expenditure includes mortgage repayments, this savings ratio refers to savings over and above mortgage repayments (in contrast to the National Accounts definition of the savings ratio). The ratio increased rapidly over time, with households moving from a typical pattern of dissaving in the 1990s to saving in the 2000s. It is notable that owner households (i.e. no mortgage) have the highest savings ratio in any given year. This very likely relates to their age profile and also the smaller level of housing costs in their expenditure. Mortgaged households experienced the most rapid increase in the savings ratio, suggesting that during those years the mortgaged households benefited over and above renters. Renting households raised their savings rate from 1999/2000, and the rate for mortgaged and renter households converged over time, despite the typically higher income and older age profile of the former category.

Figure 3 is consistent with increased levels of household disposable income. But other factors influence the savings ratio, such as: the real interest rate on savings; income expectations; age; the availability of credit; the tax treatment of savings; the development of savings institutions; and the desire to secure a deposit on a house. Income expectations seem to play a key role, especially after such a negative shock in the economy as caused by the financial crisis. We expect that in the period directly after the crisis households would be more reluctant to increase their expenses, displaying a behavioural change towards increased savings.

⁵ Note that at a given point in time, the explanation for why this ratio could be negative is due to the use of personal credit, previous savings or unrecorded income to finance current expenditure.

Figure 3: HBS median savings ratio for different household types



Source: Household Budget Survey

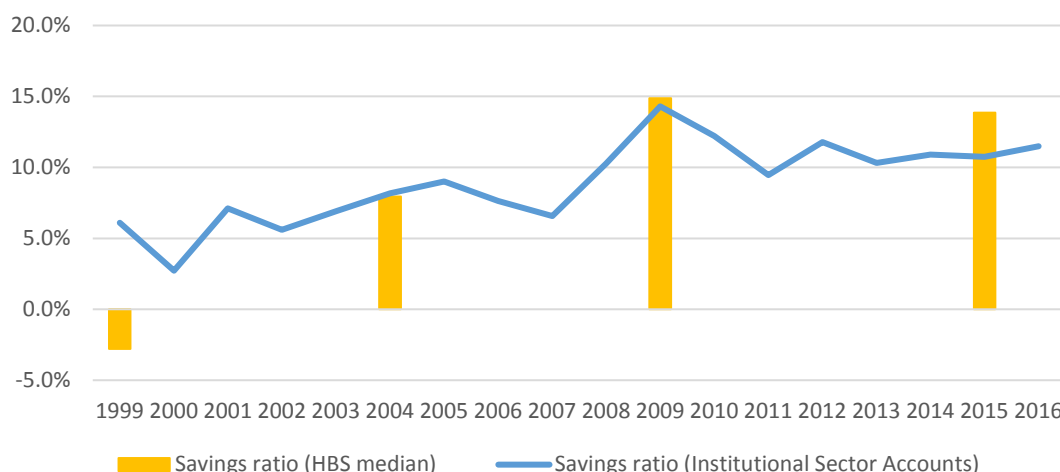
Note: each annual result is the median result for that household category in that year.

Using an alternative data source, Figure 4 confirms the increased tendency to save. The savings ratio by households (including NPISH⁶), which is the ratio of gross savings to disposable income as measured by the CSO’s Institutional Sector Accounts, increased steadily throughout the 2000s, peaked in 2009 and contracted thereafter due to the impact of recession⁷.

⁶ Non-profit institutions serving households.

⁷ The HBS publication includes pension contributions in household expenditure. Here we remove pension contributions to arrive at an adjusted value of household expenditure and instead allocates pension contributions to household savings in order ensure consistency with the CSO Institutional Sector Accounts (ISA). It is appropriate to remove pension contributions from expenditure as such contributions are viewed by households as a form of deferred consumption i.e. saving. However, the Institutional Sector Accounts definition of savings differs in two key respects. Firstly, in both the HBS publication and this paper, household expenditure includes mortgage repayments. Therefore, the household savings ratio that is created from the HBS micro-data – one minus the ratio of expenditure to disposable income – refers to savings *over and above mortgage repayments*. The ISA household savings ratio, by contrast, includes mortgage repayments. Other things equal, we would expect the savings ratio calculated by the HBS to be lower than the ISA household savings ratio. Secondly, the household savings ratio calculated in ISA includes the consumption of fixed capital (i.e. depreciation of fixed assets). Other things equal, this will also mean that the HBS ratio is lower than the ISA ratio. However, the ISA ratio is impacted by imputed rent for owner-occupiers (as this appears in the definition of final consumption expenditure, accounting for roughly ten percent of final consumption expenditure since the late 1990s). All else equal, this means that the HBS ratio is higher than the ISA ratio.

Figure 4: Institutional Sector Accounts household savings ratio



Source: CSO

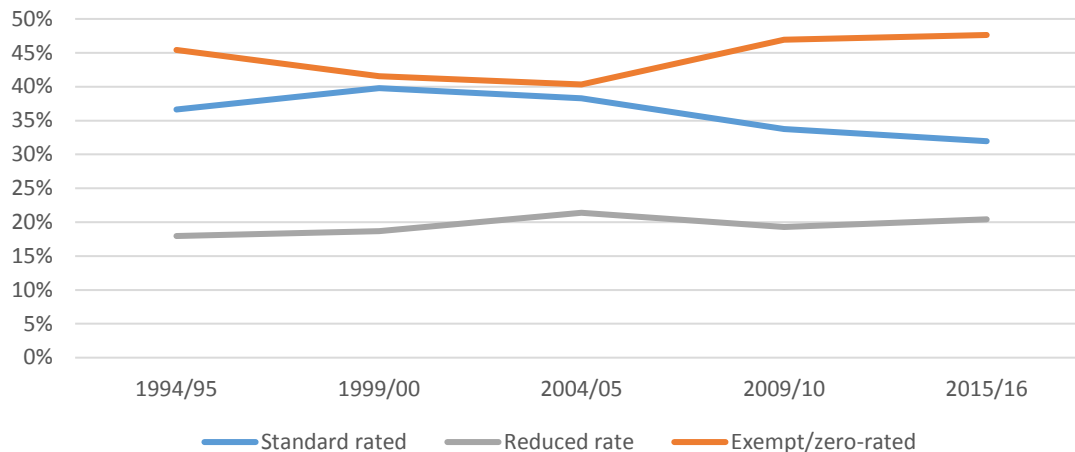
Note: in the Institutional Sector Accounts, the Household Saving Ratio is Gross Household Saving (B.8g) expressed as a percentage of total resources, i.e. the sum of Gross Household Disposable Income (B.6g) and the Adjustment for the Change in Pension Entitlements (D.8).

2.3 Changes in expenditure shares

VAT revenue elasticities can change when expenditure patterns change. Typically, as incomes increase the share of expenditure for exempt or zero-rated (mainly basic) goods decreases and the share of positive-rated goods increases. This pattern is observed in Ireland over the decade from 1994 to 2004 (Figure 5). However, the 2009/10 HBS indicates that the share of exempt or zero-rated goods in household expenditure increased sharply in the late 2000s. By 2015/16, the shares of expenditure being allocated to exempt/zero-rated was at a similar level to that observed in 1994, despite incomes being much higher in the later period. The share of expenditure going to standard-rated goods peaked in 1999 and has been on a downward trend since (accounting for 32% of expenditure in 2015/16). There was a marginal increase in the expenditure devoted to the reduced rate between 2009/10 and 2015/16 (and the latter period is the only one in which the reduced rate substantially changed, from 13.5 percent to 9 percent for expenditure predominately in the hospitality and entertainment sectors).

When comparing Irish household expenditures to the EU-average we find a similar pattern. According to data from EUROSTAT we see that almost a quarter of EU-28 household expenditure (24.5% of total) was devoted to housing, water, electricity, gas and other basic needs. Transport represents a big percentage as well (12.9% of total) and food and beverages follow with 12.2% of total. In other words, the basic needs account for almost half of the total household expenditure (49.6%).

Figure 5: Expenditure shares of different VAT-rated goods

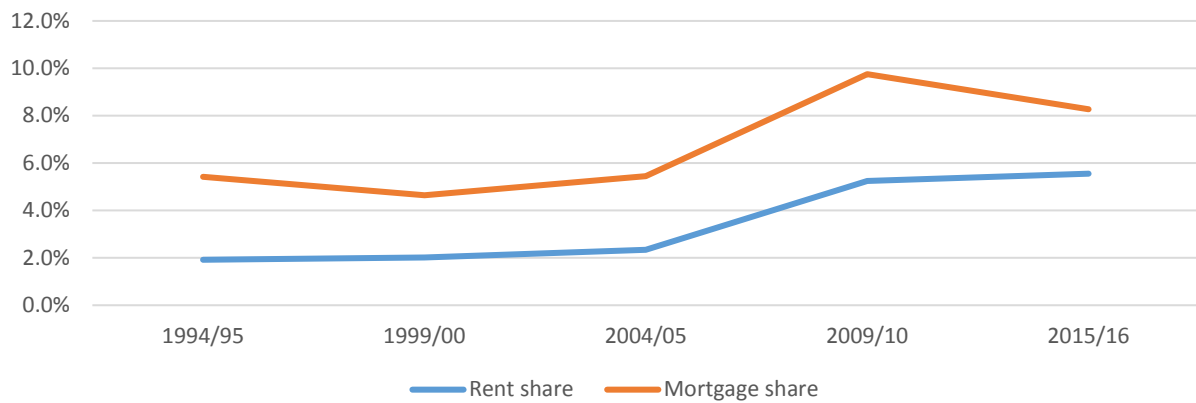


Source: Household Budget Survey

Note: definition of expenditure is not the VAT base (which would exclude exemptions by definition). Instead, it is the definition of household expenditure as used in HBS less pension contributions.

The decreasing trend of expenditure on exempt or zero-rated goods in the 1990s was followed by an increase in the late 2000s, which is identical across all points on the income distribution. This behaviour first amplifies and subsequently moderates the responsiveness of VAT revenue to changes in either income or expenditure.⁸ This pattern can be explained when we consider the various expenditure categories in the HBS and their respective tax treatments. Over time, Irish households have spent an increasing amount on housing costs, which is exempt from VAT (Figure 6). Mortgage repayments and rent as a share of total expenditure have increased substantially since the late 1990s (Figure 7). The reduction in the mortgage share in 2015/16 is due to the overall level of expenditure increasing while the level of mortgage expenditure remained stable between 2009/10 and 2015/16. Figure 7 shows again that the Irish expenditure patterns are very similar to the ones observed in EU, as food, fuel, housing, and transport account for about half of the overall expenditure.

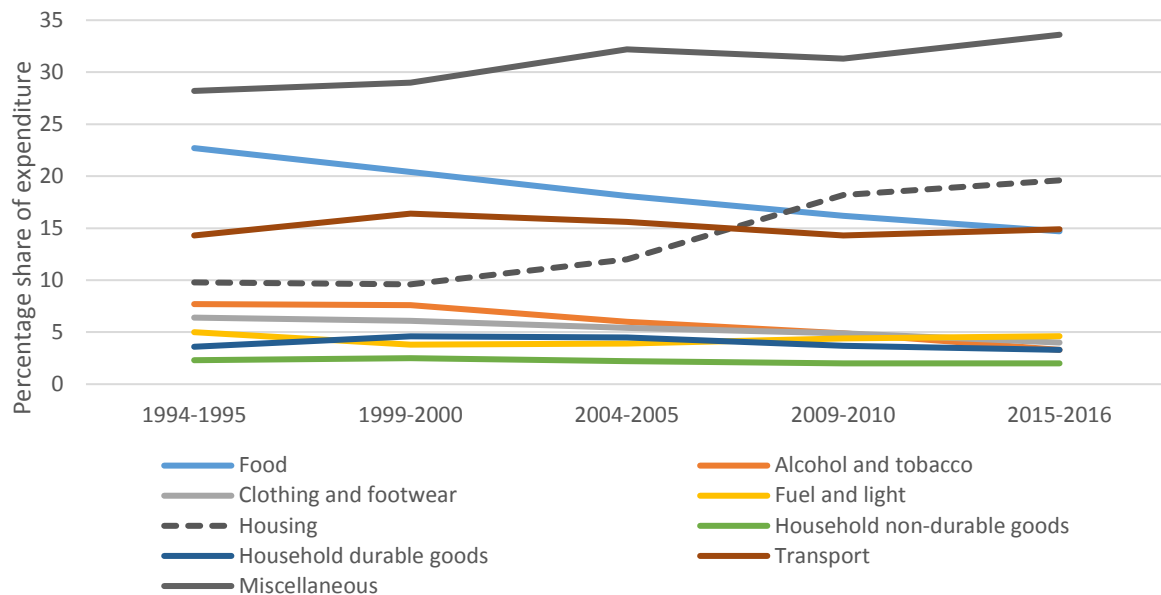
Figure 6: Share of total expenditure devoted to VAT-exempt mortgage repayments and rent



Source: Household Budget Survey

Note: definition of expenditure is the definition of household expenditure as used in HBS less pension contributions.

Figure 7: Expenditure shares for different expenditure categories over time



Source: Household Budget Survey

III. Methodology and data

This section presents the methodology we use to estimate the analytical VAT revenue elasticities. The Irish VAT structure has four tax categories with four tax rates respectively, which affect household expenditure, namely the zero-rated products and services, the 9% rate in labour-intensive and tourist sectors, the 13.5% rate applied to energy and housing, and finally the 23% for the rest of the consumption goods⁹. Those tax rates, combined with the household budget shares and disposable income, enable us to estimate the VAT revenue elasticity.

We apply the Creedy and Gemmell (2004) approach, which accounts for different responses at different points on the income distribution, using the HBS data to estimate the budget shares of the goods for the four different tax rates. Finally, we use the analysis of Acheson et al. (2017) to estimate income marginal tax rates.

Consider an individual with a gross income of y_i and a total expenditure of x_i . (Note that in this paper gross income is used as the term for taxable income). Let T_{il} denote the VAT tax paid by this individual i for the good l , and T_i to be the total VAT tax paid across all goods. When we refer to a good l we mean each good that faces a different VAT rate. Also, ϵ_{il} is the total expenditure elasticity of demand for the individual i for the good l , and mtr_{y_i} , atr_{y_i} are the income marginal tax rate and average tax rate respectively. Then the VAT elasticity is given by:

$$\Omega_{T,y_i} = \left(\frac{1-mtr_{y_i}}{1-atr_{y_i}} \right) \sum_{l=1}^n \frac{T_{il}}{T_i} \epsilon_{il} \quad (1)$$

Note that the first term in (1) can be described as the residual progressivity of the income tax system. Acheson et al. (2017) show that the income tax revenue elasticity is the ratio of the mtr to atr and this is a measure of progressivity. Thus, this term captures the fact that higher income tax rates simultaneously reduce the expenditure available to be taxed via indirect taxes. Intuitively, if income tax progressivity increases, this means that the proportion of gross income retained by households in the form of disposable income falls on the margin as we move from lower to higher income deciles, which in turn reduces the VAT revenues arising from those households.

Note that the definition of the elasticity of demand is as follows:

$$\epsilon_{il} = 1 + \frac{dw_{il}/w_{il}}{dx_i/x_i}$$

where w_{il} is the expenditure share of individual i for the good l . ϵ_{il} measures the proportional change in household expenditure on goods taxed at rate l divided by the proportional change in total household expenditure, for a given income band i . When expenditure on different VAT rated goods grows proportional to the total expenditure then ϵ_{il} is one. However, usually we observe changing expenditure patterns over time and different expenditure shares for different rated goods over the income distribution.

To estimate the elasticity with respect to expenditure, we need to introduce in our analysis the marginal propensity to consume and consumption expenditures, given by γ_i and C_i respectively for the individual i . Then the responsiveness of VAT revenue with respect to expenditure is given by:

$$\Omega_{T,c_i} = \frac{C_i \Omega_{T,y_i}}{\gamma_i (1-mtr_i) y_i} \quad (2)$$

From equations 1 and 2 we observe that the elasticity increases as marginal tax rates increase, but that impact comes through the increasing average tax rate (which changes less than proportionally). Also, note that elasticity 2 will be higher than elasticity 1 as it concerns the tax base itself. In particular, the fact that the second elasticity directly captures the changes on the VAT revenues caused by changes in the expenditure means that we are expecting a larger value, as the ratio of VAT revenues over expenditure is larger than the ratio VAT revenues to disposable income, which also includes savings as well as expenditure.

To derive the above elasticities, we use data from the last five waves of the HBS. First, we estimate the elasticity ϵ_{il} by running a regression of the expenditure shares of the different VAT-rated goods on total expenditure. For the second step of our analysis we estimate the marginal and average income tax rates. In particular, atr is taken directly from the HBS data, whereas mtr is calculated as the sum of the income tax rate, health levy, income levy and USC at any given income level. It is important to note that the household's marginal tax rate will depend on its composition. For example, a single earner will face a higher marginal tax rate than a two-earning couple, at certain income levels. Thus, to calculate the household's mtr we take into account the household composition (single/married) and the number of workers in the household. Then, we will estimate equations (1) and (2) for the three taxpayer types, namely singles/widowed, married with one earning individual and married couples with two earning individuals. It should be noted that due to a lack of data we are not able to capture cases where the children do work but still live in the parental home.

In the third step of our analysis we estimate the consumption expenditures, C_i which are calculated by the HBS as the sum of the consumption expenditures for each category, and for each VAT-rated good. Then, the marginal propensity to consume, γ_i , is derived from the HBS data as the ratio of expenditure to disposable income. This means that the savings behaviour of the households directly influences the size of the elasticity. Similarly, to obtain the tax revenue of each different category for each different VAT rate, we multiply the above expenditure to the four different VAT rates to sum them up and get the VAT tax paid by individual i for the good l , T_{il} , the total VAT tax paid, T_i .

In the fourth step we estimate the size of elasticity 2 using the product rule of elasticities⁸. The total elasticity is a composite of the change in the tax base and the change in the taxable activity (e.g. income). Thus, the total VAT elasticity can be written as the product of the effect on tax payments of a change in the tax base and the effect on the tax base of a change in income (Creedy and Gemmell, 2006):

$$\Omega_{T,y_i} = \Omega_{T,c_i} * \Omega_{c_i,y_i}$$

Ω_{c_i,y_i} is the elasticity of the expenditure with respect to gross income and it shows how much the expenditure pattern changes for changes in gross income.

Before we proceed with the results it is important to note that expenditure follows the definition of the HBS, but in our analysis we exclude pension contributions. This may have

⁸ This is analogous to the product rule in differential calculus.

some consequences for the interpretation of distributional analysis of VAT revenues as the share of expenditure going toward pension contributions is close to zero in the first three deciles but over 10% in the top decile. Also, our results will be over-estimating the VAT revenue from goods which are liable for excise, but we expect that this is countered by the fact that individuals under-report alcohol/cigarette expenditure in budget surveys⁹. Murphy (1976) estimates that the under-estimation is of the order of 60%, which is also true for 2015/16 data when we compare them to the expenditure data of the National Accounts. This is further discussed in the appendix where we compare the HBS variables to data from other sources.

IV Results

4.1. Baseline results

4.1.1. Response of VAT revenues to changes in household gross income

The VAT elasticity in equation (1) is the responsiveness of VAT revenues from the household sector to changes in gross income. In Figure 8 we see the trend of the value of this elasticity (solid line). We observe that as the VAT system itself has been reasonably constant over the twenty-year period under review (with the exception of the new 9 percent rate in 2011). The two key elements which determine the trend of this elasticity are the income tax system and the expenditure patterns.

When it comes to the expenditure patterns, if the share of expenditure on goods and services liable to VAT at the standard rate increases, then the elasticity will increase; conversely, increased expenditure shares on zero-rated or exempt goods and services will reduce the elasticity. Figure 4 demonstrated that the typical household increased its share of expenditure on positive rated expenditure items between 1994/95 and 2004/2005, but that the share declined thereafter as housing costs increased. This change in expenditure patterns implies less VAT revenue for a given level of expenditure (or income) in the later years, and so the VAT elasticity would decline.

From Figure 8, we observe that the elasticity steadily increased until 2004/05 before it decreases in 2009/10. The initial upward trend is primarily explained by decreasing marginal income tax rates over this period. However, the doubling of the health levy and the introduction of the income levy in the 2009 Budgets caused a notable decrease in the VAT elasticity in 2009/10, as marginal income tax rates increased for households.

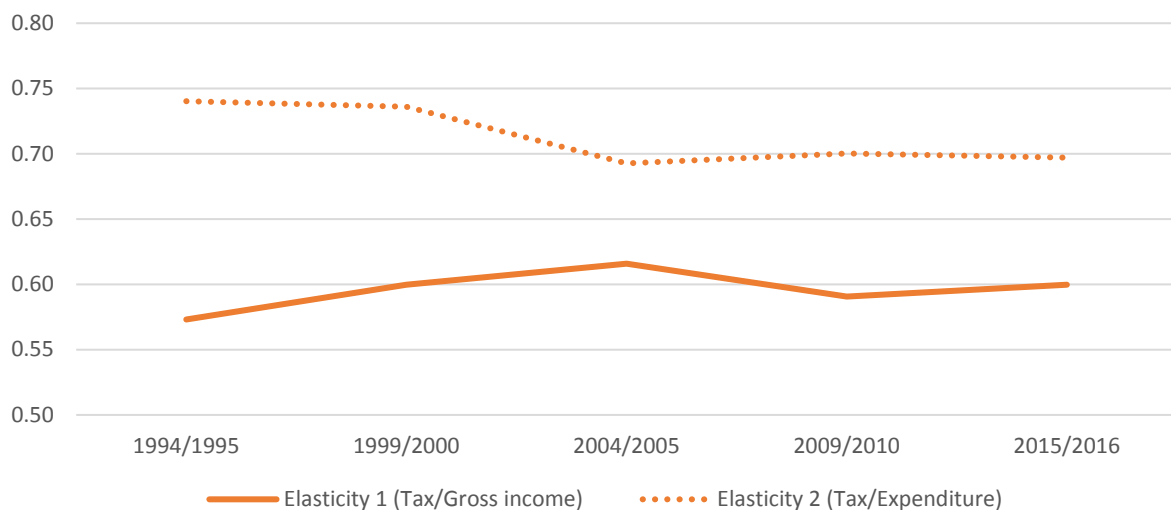
During the financial crisis, one of the key revenue-raising measures was to increase income tax revenue by introducing a new levy in 2009 and subsequently USC in 2011. Other things equal, an increase in the marginal tax rate increases the income tax revenue elasticity (meaning more revenue is automatically collected for a given percentage increase in gross income). As discussed in the methodology section, there is a connection between income tax

⁹ Our calculations focus on VAT and do not capture the effect of excise, which affect consumer behaviour and thus the tax revenue elasticity.

and VAT stemming from the marginal income tax rates. In this paper, our analytical estimation of the VAT revenue elasticity enables us to capture this spill-over effect. As marginal income tax rates increase, the VAT revenue automatically generated from an increase in gross income *decreases*. The combined revenue impact is thus less than may have been assumed at the time of the policy change.

In 2015/16, the VAT revenue elasticity is estimated at 0.6, only marginally higher than in 2009/10, suggesting that the implementation of USC has a similar impact on VAT revenues as the previous levies. This result means that for every one percent increase in gross income, VAT revenues are expected to automatically increase by 0.6 percent (under the current VAT and income tax systems). The VAT revenue elasticity is income inelastic as, on the margin, a progressive income tax system reduces the gross income available for expenditure, particularly for higher income households.

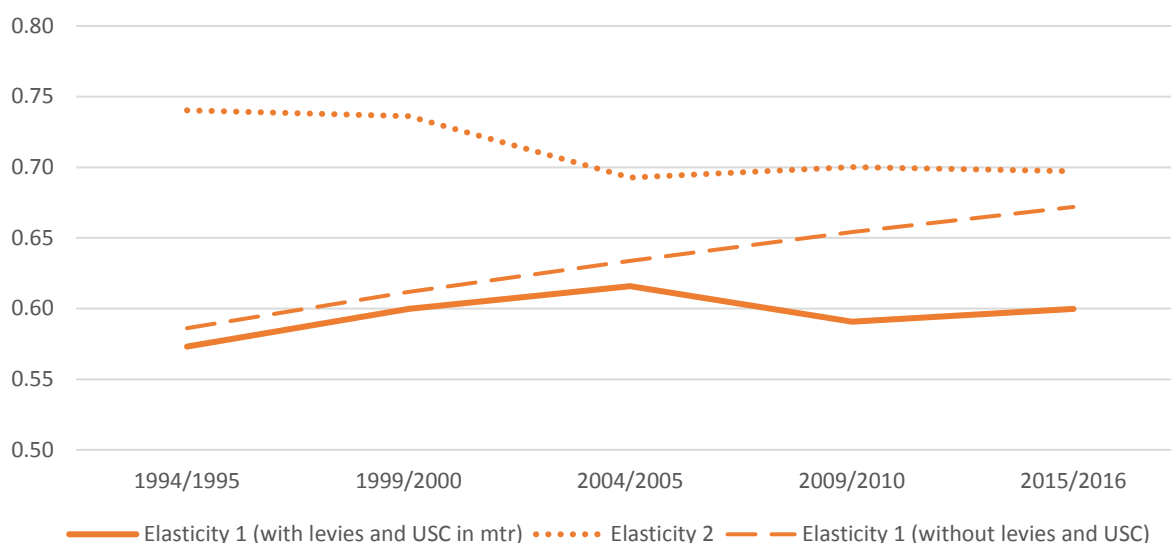
Figure 8: VAT elasticity baseline results



Note: expenditure here is defined as the HBS definition less pension contributions. In 2004/05, spending on SSIA's is also excluded as this is a form of saving.

Changes in expenditure patterns play a weaker role in the elasticity compared to changes in the income tax system. This can be demonstrated by removing the health and income levies and USC from the calculation of the marginal income tax rate in all years. Figure 9 shows that when we remove these additional taxes on income, the VAT elasticity with respect to gross income rises smoothly throughout all years. This is explained by the fact that marginal rates of income tax in this scenario fell throughout the period. Both calculations of the elasticity in Figure 9 rely on the same expenditure patterns, which indicates that the income tax system has a stronger influence on VAT revenues than even the notable developments in the Irish housing market over this time.

Figure 9: the influence of the income tax system on elasticity (1)



Note: expenditure here is defined as the HBS definition less pension contributions. In 2004/05, spending on SSIA is also excluded as this is a form of saving.

The low value of the VAT revenue elasticity compared to other countries (0.6 in 2015/16) likely reflects the more progressive nature of the Irish income tax system compared to other OECD countries. The estimate for the UK in the 1990s is approximately 0.7, 0.8 for Australia in the mid-1990s and 0.9-1.0 in New Zealand in 2001, depending on assumptions about savings (see Creedy and Gemmill (2004, 2006, 2003) for further details).

4.1.2. Response of VAT revenues to changes in household expenditure

The VAT revenue elasticity with respect to expenditure is higher than the elasticity with respect to the gross income for all years (Figure 8).¹⁰ This is expected as VAT revenues will be more responsive to direct changes in their base (expenditure) than to a variable that only partially determines the base (gross income). As the elasticity with respect to gross income is used to calculate the elasticity with respect to expenditure both elasticities are impacted in an identical way by changes in expenditure patterns.

However, the elasticity with respect to expenditure is impacted by the income tax system in a unique way, as it is only the average tax rate that influences the result. Equation 2 shows that the elasticity increases as the average tax rate increases, albeit less than proportionally. This suggests that in a more progressive income tax system, such as the Irish one, the higher-income household spends more on VAT than a lower-income household.

Another difference between the two elasticities is that the impact of savings behaviour is explicitly modelled in the second one with respect to expenditure. This makes sense as a

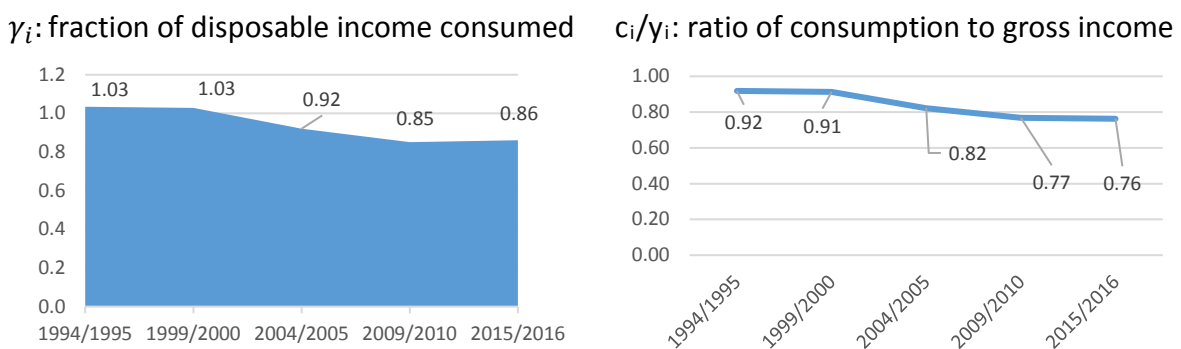
¹⁰ Running a log-log regression as a robustness check on our calculations, using CSO Personal Consumption Expenditure and Exchequer VAT revenue data, gives a higher value for the elasticity. This higher value can be explained by the fact that Exchequer VAT revenues include VAT from all sectors (not just households) and also includes VAT arising from the sale of new houses.

marginal change in gross income will occur independently of savings while a marginal change in expenditure will occur conditional on a savings decision. In equation 2 the ratio of expenditure to gross income (c_i/y_i) will provide an indication of the savings ratio (for a given income tax structure). Besides, γ_i is the marginal propensity to consume out of disposable income and it moves inversely with the savings ratio.

The most notable feature of the VAT elasticity with respect to expenditure in Figure 8 is the downward shift between the 1990s and the 2000s. This shift is explained by the change in savings behaviour as the ratio of expenditure to gross income declined notably between the 1990s and 2000s, indicating increased levels of savings, with the most substantial change occurring in 2004/05 (see Figure 10).¹¹ This change in the relative level of savings occurred at the same time as all households experienced falls in marginal income tax rates and the behavioural change is likely to be at least partially explained by this.¹²

However, as can be seen in both Figures 10 and 3, savings also rose in 2009/10, so all else equal we would expect to see a steadily declining elasticity in 2009/10 rather than the observed level shift. But this is not the case as in 2009 the country experienced two Budgets which increased the health levy and introduced an income levy. As a result, average tax rates and marginal tax rates increased. The level shift can thus be explained by a combination of increased savings in the 2000s relative to the 1990s and a one-off sharp increase in income tax in 2009, which counteracts the impact of increased savings in that year. This suggests that the crisis changed the behaviour of households, in that they derive a higher utility from savings than consumption. This implies that the crisis has altered the expectations of households with regard to future income, at least over the observed period.

Figure 10: components of elasticity 2 for the median household



To better understand how changes in the income tax system affect VAT elasticity we perform a robustness analysis where we consider a scenario where tax credits were not introduced in

¹¹ We note that the 2004/05 HBS contains data on household contributions to the Special Savings Incentive Account (SSIA) scheme. This variable is excluded from the paper's definition of household expenditure and is therefore included in the savings ratio.

¹² Other factors that influence the savings ratio – which we may need to discuss – are: interest rates (low in this period); availability of credit (high in this period); expectations of future income (high in this period); taxation of saving (low in this period); negative equity (low in this period); developments in housing market.

April 2001 and the tax-free allowance system continued into the 2000s. The analysis is performed by setting the average tax rate for all households at their 1999 pre-tax credit levels for the years 2004/05, 2009/10 and 2015/16. As can be seen from Figure 11, there is no level shift in the elasticity in the 2000s when it is adjusted in this manner (note that savings and expenditure behaviour remain identical for the two elasticities in the figure). However, this scenario demonstrates how the tax credit system plays an important role in determining average income tax rates and the VAT elasticity with respect to expenditure.

Figure 11: the influence of the tax credit system on elasticity (2)

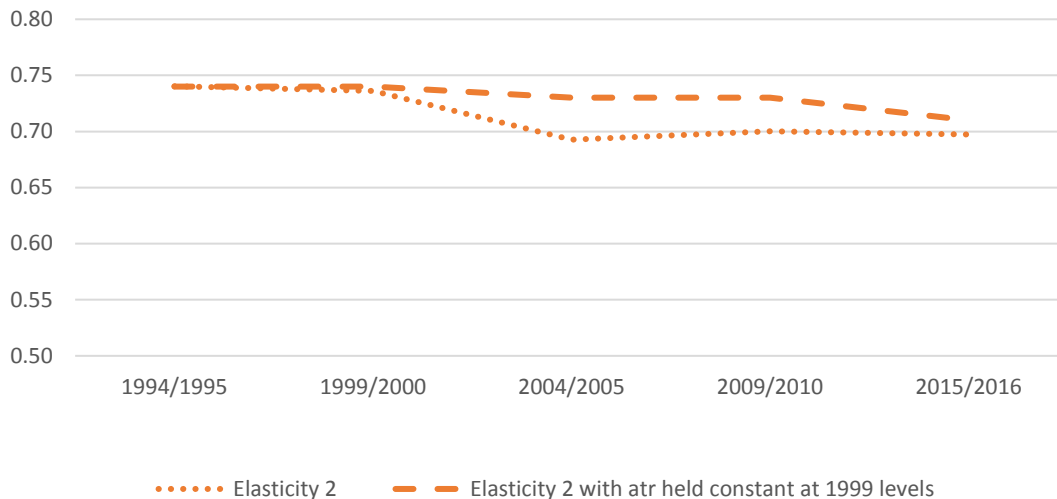


Figure 12 highlights the average tax rates over the period when the Irish income tax system changed for different indicative income levels. Between 2000 and 2002, average tax rates reduced sharply by between 4 and 9 percentage points.¹³

Figure 12: Average tax rate for Single taxpayer



Source: Budget 2004 documentation, available at www.budget.gov.ie

¹³ 2000 and 2002 are compared as these represent 12-month periods. The 2001 year was only nine months (from a Budget perspective).

Note: the Single taxpayer pays the full rate of PRSI. The short calendar year in 2001 lasted nine months from 1 April to 31 December, in preparation for the switch from an April to April fiscal year to a January to December fiscal year.

2.2. VAT revenue elasticity and the housing market

To further explore the relationship between VAT revenues and the housing market, in this section we try to disentangle the part of the expenditure which is devoted to housing. During the period examined, the share of expenditure devoted to housing increased considerably. With mortgage repayments and rent both VAT-exempt this could have a substantial impact on VAT revenues. To examine this, we create a disaggregated version of the baseline elasticities for three household types: owners, mortgage-holders and renters. It is evident that the latter two categories, mortgage-holders and renters, have different expenditure patterns than owners who do not display the same housing costs. It is also possible that the savings patterns of all three categories have changed in reaction to developments in the housing market. For owners and mortgage-holders, a wealth effect may have reduced the need for precautionary savings. For renters, savings may have increased in reaction to rising house prices. Furthermore, all three categories' savings ratios could plausibly be affected by changes in the income tax system too.

Our disaggregated VAT elasticities with respect to gross income are reasonably similar across tenure types. In the 2000s, the owner elasticity is slightly higher than the other two tenure types, as owners have a slightly higher propensity to spend on standard-rated goods. This is noteworthy as the typical owner household has a lower income than a mortgaged household, but for the latter group VAT-exempt mortgage repayments make up a large share of their expenditure. This result highlights the importance of expenditure composition in determining VAT responsiveness, which will be influenced to some degree by the tenure of households and developments in the housing market.

The VAT elasticity with respect to expenditure is similar for renters and mortgaged households, but the owner elasticity is notably lower. This reflects their higher savings ratios (see Figure 3). All three tenure types show the same level shift in this elasticity between the late 1990s and early 2000s (i.e. after the introduction of the tax credit system). Overall, the results for both types of elasticity suggest that developments in the income tax system - falling marginal tax rates and the switch to tax credits - are a more prominent explanation for VAT revenue responsiveness than developments in the housing market.

We note that older research using the HBS found no evidence for changes in the marginal propensity to consume triggered by changes in the housing market (IMF, 2006; ISSP, 2003). A possible explanation of this is that the households view the wealth increases (i.e. house price increases) as transitory, strong bequest motives come with this form of wealth, increased investment rather than consumption (e.g. house extensions) and also the inability to draw equity out of the housing asset. More recent research (McCarthy and McQuinn, 2014) found evidence of a wealth effect, but tested the elasticity of consumption with respect to house prices, rather than the MPC, with the latter being the more standard indicator of a wealth effect.

V Conclusions and Policy Discussion

This paper estimates analytical estimates of the VAT revenue elasticities with respect to gross income and expenditure in Ireland for the period 1994-2016. To do so we use data from the last five waves of the Household Budget Survey. The size of the elasticity suggests that a 1% increase in gross income automatically increases VAT revenues by 0.6%. A 1% increase in expenditure automatically increases VAT revenues by 0.7%. This is lower compared to estimates from other countries.

The responsiveness of household VAT revenues to changes in household gross income steadily increased up to the late 2000s as marginal income tax rates fell, leaving households with higher post-tax incomes. However, the introduction of the income levy and the doubling of the health levy in 2009 caused a notable decline in the automatic responsiveness of VAT revenues to income growth, as higher income tax rates reduced disposable income available for expenditure and hence the potential base to be taxed via indirect taxes. This spill-over effect highlights the importance of judging tax policy in the round and not at the level of one individual tax. It also suggests that policymakers during any subsequent fiscal crisis should be cautious when choosing the composition of tax adjustments, as there is a clear trade-off to be made.

Expenditure patterns changed over the 1990s and 2000s, as households increased their spending on VAT-exempt goods and services (in particular housing). Typically, rising disposable incomes are associated with an increasing expenditure share devoted to standard-rated goods (i.e. non-essential items). However, as Ireland's VAT code exempts housing expenditure such as mortgage repayments and rent, and Ireland experienced a housing bubble over the period over review, this reduces the elasticities. However, and perhaps surprisingly given the developments in the housing market, this had a weaker impact on the VAT elasticity than developments in the income tax system.

The trend of the elasticity during the period examined is highly affected by saving-expenditure patterns of the households. Increased household savings ratios caused a reduction in the VAT elasticity with respect to expenditure. The fact that mortgaged households and owners do not behave similarly in terms of expenditure composition and savings behaviour is interesting. From the point of view of VAT revenues from the household sector, the key distinction may not be property-holders vs non-property holders but outright owners vs others.

Elasticity (2) is the most relevant one for tax forecasting. Currently the Department of Finance uses an elasticity of 1.0 to forecast VAT revenues from all sectors of the economy, whereas our results suggest a value of 0.7 specifically for VAT revenues from the household sector. The elasticity derived here takes account of: (i) changes to the income tax system; (ii) changes in savings behaviour; and (iii) changes in expenditure composition, all at different points on the income distribution. Importantly, as the calculation in the paper only concerned the household sector rather than all sectors who pay VAT, and the fact that the elasticity is not stable over time (unlike the income tax/USC revenue elasticities in Acheson *et al.* (2017)), further analysis is required before a recommendation for tax forecasting can be made.

However, it is clear from the analysis that changes in both savings behaviour and expenditure composition are critical in determining the automatic responsiveness of VAT revenues to changes in its base. Given the number of factors determining the VAT elasticity and the fact that very different sectors are subject to VAT, it would be advisable to carry out more study on VAT forecasting in future.

Appendix Table: details on HBS

HBS wave	Survey time period	Number of households surveyed
1994-1995	May 1994 and July 1995	7,877
1999-2000	June 1999 and July 2000 inclusive	7,644
2004-2005	October 2004 and December 2005 inclusive	6,884
2009-2010	August 2009 and September 2010 inclusive	5,891
2015-2016	February 2015 and February 2016 inclusive	6,839

Appendix Table: checking HBS data against other sources of aggregate data

HBS wave	Total VAT revenue calculated in HBS as proportion of <u>household</u> VAT revenue from Exchequer returns*	Total household expenditure calculated in the HBS as a proportion of final consumption expenditure of households and NPISH in the Institutional Sector Accounts	Total household expenditure calculated in the HBS as a proportion of final consumption expenditure of households and NPISH in the Institutional Sector Accounts <i>less imputed rent</i> **
1994-1995	73%	73%	80%
1999-2000	70%	77%	87%
2004-2005	65%	79%	90%
2009-2010	68%	73%	84%
2015-2016	71%	81%	94%
Average	69%	76%	87%

* Note data from the Exchequer returns do not distinguish VAT liabilities by sector. However, the European Commission has estimated the share attributable to the household sector and this analysis is used in this calculation (European Commission, 2017). Typically, the household sector's share is roughly two-thirds of total VAT liabilities.

**Imputed rent is included in the Institutional Sector Accounts to ensure home ownership patterns do not distort macroeconomic aggregates. It is not appropriate to include it when making a comparison with household-level microeconomic data.

The low coverage of household VAT revenues in the HBS (69 percent of the equivalent Exchequer figure on average) is partially explained by the well-known under-reporting of expenditure on alcohol and tobacco in household surveys. In 2015/16, for example, this under-reporting accounts for roughly half of the gap between the HBS estimate of VAT revenues and the equivalent figure derived from the Exchequer returns.

The HBS estimate of expenditure is reasonably similar to the estimate from the Institutional Sector Accounts when this figure is adjusted for imputed rent (87% coverage on average).

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