Progressive VAT? The redistributive effects of VAT rate differentiation

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Abstract

VAT is normally considered to have regressive distributional effects on income distribution. Many countries try to address distributional concerns with rate differentiation. Based on Swiss data we find that both the existing VAT as well as a revenue-neutral flat rate have no significant redistributive effects on the Gini coefficient. Further, we show that differentiated VAT rates only have weak intended distributional effects and that a different VAT structure can also not make VAT progressive regarding income. Based on our results, we conclude that introducing a flat rate should be considered.

Keywords: value added tax; VAT burden; redistributive effect

JEL classification: D31; D63; H23; H24; H31

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1. Introduction

Following the financial crisis 2008, many European Union (EU) countries increased their standard VAT rate (Keen, 2013). In Switzerland, VAT rates have also increased continuously since its introduction in 1995 (see Table 1). However, interestingly, Keen (2013) shows that VAT revenues have, in the last two decades, been driven by changes in C-Efficiency[1] as opposed to the standard rate. Moreover, for EU member countries, Keen (2013) decomposes the deviation from 100 percent C-Efficiency into two parts: one part stemming from rate differentiation and exemptions (called 'policy gap') and the other part stemming from imperfect VAT implementation (called 'compliance gap'), where the former is identified as mostly being by far the larger part. In conclusion, VAT revenue could potentially be increased without increasing the standard rate by decreasing the policy gap. However, the implementation of a VAT rate structure, i.e. the decision for or against differentiated VAT rates, is complex because there are various aspects to be considered.

VAT rate differentiation can have causes and implications in a variety of areas: in political-economic, distributional or efficiency aspects, as well as in collection and payment costs. Considerations relating to collection and payment costs and many political-economic arguments promote a flat rate: differentiated tax rates increase the administration costs for both tax authorities[2] and companies as taxpayers.[3/4] Further, existing differentiated tax rates might increase the likelihood that lobby groups also claim reduced tax rates (Bundesrat, 2005, pp. 53/56).[5/6] Another problematic feature of differentiated VAT rates might be that they do not distinguish between vertical and horizontal equity, as, for example, outlined by Homburg (2010, p. 198 f.).[7] By contrast, efficiency and distributional considerations promote, at least in theory, differentiated VAT rates. However,

[1] The C-efficiency ratio corresponds to the ratio of VAT revenue share in consumption expenditures to standard tax rate. Therefore, a uniform rate on all consumption expenditures has a C-efficiency ratio of 100 percent (Ebrill et al., 2001).

[2] According to Agha and Haughton (1996) compliance is considerably lower and the administration costs are higher with differentiated VAT rates.

[3] See, for example, Rambøll Management (2007) for an estimation of the cost-saving opportunities of the companies given by introducing a flat rate.

[4] Differentiated VAT rates also increase the tax risk for companies (Eidgenössische Finanzkontrolle EFK, 2007). A study of KPMG Switzerland in cooperation with the University of Zurich analyses the VAT risks for companies (see KPMG and Universität Zürich, 2004). A later study (see Bundesrat, 2005, p. 167 f.) outlines how these VAT risks might change by introducing a flat rate: essentially all analysed VAT risks can be reduced.

[5] See, for example, Cnossen (1998) outlining that 'it is difficult to keep the coverage of a reduced or zero rate within its original bounds' (p. 247) and even when privileged treatment is not extended, answering queries from interest groups requires time that could otherwise be spent on checking compliance.

[6] See also a study of the Swiss Federal Audit Office (SFAO) (Eidgenössische Finanzkontrolle EFK, 2007) for further information regarding additional costs due to differentiated tax rates.

[7] Homburg (2010, p. 198 f.) argues using the example of a luxury tax.

tax rate differentiation based on distributional considerations may contradict differentiation based on efficiency considerations (e.g. certain goods should be taxed with reduced rates from a distributional perspective and with high rates from an efficiency perspective).[8] In practice, differentiated VAT rates are generally justified by the political argument for more equal redistribution. Reduced VAT rates for basic goods allow for the possibility for elements in the VAT system to be included, which could have a progressive effect (Bundesrat, 2005, p. 53 ff.). Nevertheless, the efficiency of differentiated tax rates for distributional reasons is, in general, viewed sceptically in the literature (see, e.g., OECD/EU, 1998, p. 91 ff.; OECD/Korea Institute of Public Finance, 2014, p. 68 f.). Important to note is that differentiated rates firstly, only affect distribution in combination with different consumption patterns between households and secondly, are only one of two causes of the redistributive VAT effect on income distribution. This can be attributed to:

1. differing consumption propensities between households − because VAT is levied on consumption as opposed to income.

2. differing consumption patterns between households − because of the differentiated tax rates.[9]

Against this background, the aim of this paper is twofold: First, we examine the redistributive effects of the current and of potential VAT rate structures based on Swiss data and analyse the drivers of these effects with a focus on the contribution of differentiated VAT rates. Second, the possibilities and limitations of rendering VAT progressive are investigated. It can be crucial as to whether the VAT effect on the income or expenditures distribution is analysed. Therefore, we pursue both approaches.

We find, measuring the VAT burden per decile of equivalised gross income and relative to income indicates that VAT has a regressive impact. If measured per decile of equivalised consumption expenditures and relative to expenditures, VAT seems to have a progressive impact. A cause for the progressive VAT effect (if the VAT burden is measured relative to expenditures)

[8] See, for example Crawford, Keen and Smith (2010) showing, based on examples, that a potential contradiction might exist.

[9] As respective consequences of the first and second cause, persons or households with

- identical income and different total expenditures
- identical total expenditures and different expenditure patterns

are subject to different VAT burdens.

can be found in the fact that households with lower equivalised consumption expenditures have a lower consumption share of goods and services taxed at the normal VAT rate. The regressive VAT effect (if the VAT burden is measured relative to income) is caused by higher saving rates of households with higher equivalised gross incomes. However, measuring the redistributive VAT effect of the existing VAT system based on the Gini coefficient,[10] no significant effect can be found (regarding either expenditures, or income distribution). The same is true for a revenue-neutral flat rate. Nevertheless, the introduction of a revenue-neutral flat rate would still have a statistically significant effect on the average VAT burden of most equivalised deciles compared to the existing VAT system. Caution is also advised when increasing the VAT burden, because it might cause significant regressive redistributive effects on the income Gini coefficient. We also find that different consumption patterns between households combined with differentiated tax rates[11] only have a minor effect on the overall redistributive VAT effect measured by the income Gini coefficient. This effect is statistically insignificant even with tripled VAT rates. Further, analysing the shares of gross income spent on various groups of goods and services, we find that these shares diminish with increasing income for all analysed expenditure groups except for one.[12] We also find that, on a detailed expenditure level, only a few (consumption) goods and services can be identified whose shares of gross income increase with income. Therefore, we conclude that it is not feasible to implement a VAT structure with an equalising effect on income distribution.

The remainder of this paper is structured as follows: The next section reviews the existing literature on the redistributive VAT effect. Section 3 outlines commonly used approaches to measure inequality, progression and the redistributive effect of taxes. We then describe the applied methodology, the data and the simulation approach. In Section 5, we analyse consumption patterns and saving rates of households in Switzerland and examine the VAT burdens per decile. Section 6 outlines the redistributive VAT effect on the Gini coefficient. In Section 7, three VAT scenarios and their effects are simulated. In Section 8, we isolate the effect of different consumption patterns combined with differentiated tax rates on the Gini coefficient. Next, the possibilities and

[10] See Section 3 for more information about the Gini coefficient and for explanations regarding various indices to measure progressivity, inequality and redistribution.

[11] In the following, with the notation differentiated rates, we only refer to the reduced and special rate, i.e. not to tax exemptions; otherwise it will be stated.

[12] No correlation could be found between income and income share spent on 'presents and invitations'.

limitations to obtaining an equalising impact on the income distribution with VAT are analysed. The last section comprises a summary and conclusion.

2. Literature review

2.1 International literature

In this subsection, we review recent international literature for Western and European countries on redistribution of VAT in general and VAT rate differentiation in particular, without claiming to be comprehensive.

Distributional analyses for a variety of countries can be found in CPB Netherlands Bureau for Economic Policy Analysis (CPB) (2013) and OECD/Korea Institute of Public Finance (2014).

Based on aggregated data from national HBSs, CPB (2013) analyses the redistributive VAT effects on households for all 27 EU member countries stemming from the current rate structures and from reform scenarios.[13] The authors point out the difficulty in drawing general conclusions valid for all countries. However, in all countries, the higher income classes pay more VAT than the lower ones in absolute figures. Relative, i.e. in percent of total expenditures, VAT is regressive in Hungary, approximately proportional in 11 countries and progressive in 15 countries. Further, CPB (2013) finds that an abolition of zero and reduced rates (scenario 1) leads to effects on the relative VAT burden (in % of expenditures) across the income distribution and on the average VAT rate, which differ considerably between the analysed countries. However, in all countries, the absolute VAT burden increases more for higher income classes due to scenario 1. The results also reveal that in most countries, due to the consumption patterns, the introduction of a revenue-neutral flat rate would be in favour of the higher income households, at least when measuring the VAT burden relative to expenditures.[14] Based on national HBS data, OECD/Korea Institute of Public Finance (2014) examines the distributional effects of consumption taxes in 20

[13] In addition, CPB (2013) analyses VAT effects on non-households and VAT revenue and, based on a general equilibrium model, the effects of VAT scenarios (not identical with the ones above) on macroeconomic indicators and on average VAT rates of various sectors.

[14] For further redistributive VAT analyses, CPB (2013) also disaggregates households according to demographic criteria. Moreover, for each country, the three commodity categories with the highest VAT expenditures of households and their individual and combined share on total VAT expenditures are identified.

OECD countries across equivalised income and equivalised expenditure deciles and for different demographic characteristics. The results show that VAT systems are regressive when measured relative to income and in general proportional or slightly progressive when measured relative to expenditures. Moreover, the effectiveness of reduced VAT rates to support the poor is analysed by simulating an abolition of zero and reduced rates: the distributional effects of the various reduced rates vary, depending on the underlying policy rationale for implementing it.[15] Therefore, distributional effects of the various reduced VAT rates vary in many countries between the (groups of) goods and they also vary between the countries. However, most reduced VAT rates implemented to support the poor have the intended progressive effect relative to expenditures. Nevertheless, richer households profit in aggregate at least as much from these reduced rates as the poor, in some cases considerably more. Reduced VAT rates implemented for "non-distributional" aims, have often a regressive impact (relative to expenditures and in absolute terms).

Based on Household Expenditure Survey (HES) data, O'Donoghue, Baldini and Mantovani (2004) examine the progression and distributional effects[16] of overall indirect taxes in 12 EU-countries and compare these with income taxes, social security contributions and social benefits. They find that VAT is regressive relative to income due to savings that increase with income. However, when measured relative to total expenditures, VAT increases slightly with income in most countries, because poorer households tend to consume goods with reduced VAT rates. Further, the contribution of different commodity groups to the redistributive effect of indirect taxes is analysed.[17] Decoster et al. (2010) also compare the redistributive effect of consumption taxes with that of other taxes by simulating a shift from labour to consumption taxation, given government budget neutrality, for 5 European countries (Belgium, Greece, Hungary, Ireland, UK).[18] The distributional effects are measured by calculating the indirect tax burden relative to disposable income and relative to nondurable expenditures respectively, each by decile of equivalised

[15] The OECD/Korea Institute of Public Finance (2014) also illustrates the average tax expenditures (absolute and in % of expenditures) per income and expenditure decile respectively due to expenditures for goods taxed with reduced rates overall and for individual (groups of) goods.

[16] Progression is measured by the Kakwani index and distributional effects by the Reynolds-Smolensky index and by measuring tax burden relative to disposable income and expenditures respectively, each by deciles of equivalent income.

[17] Across countries, the commodity groups food, household goods, clothing and footwear, other goods and services and transport increase inequality by most.

[18] Based on the correlations between expenditure elasticities and indirect tax rates, Decoster et al. (2010) also examine whether the tax systems are more inspired by distributional or efficiency considerations.

disposable income, the Suits index and the Reynolds-Smolensky index. According to the results, indirect taxes are proportional or progressive relative to total expenditures, but regressive relative to disposable income, which is mainly due to the saving rate. However, indirect taxes are in any case less progressive than other components of the tax system.[19] Kaplanoglou (2004) also includes several countries in her study by comparing the structures of the indirect tax systems and consumption patterns between the United Kingdom (UK), Greece and Hungary, based on HBS data. Several calculated consumption inequality measures (Gini, Atkinson, Theil index) reveal that Hungary is clearly more egalitarian than UK or Greece. However, all three analysed indirect tax systems generate about two-third of their revenue from only ten commodity groups. Further, Kaplanoglou (2004) finds that the structures of the three analysed indirect tax systems converged over the last decade and lost on distributional effect. In addition, with the simpler UK system, inequality could be reduced in Greece and Hungary compared to their current systems.

Various distributional VAT analyses for individual countries also exist. Caspersen und Metcalf (1994), for example, measure VAT incidence of two theoretical VAT systems in the United States (US). According to the results, a flat rate VAT would clearly be regressive relative to annual income, only modestly regressive relative to two different measures of lifetime income and proportional relative to current consumption (as proxy for lifetime income). A zero rating of food, housing and health expenditures reduces the regressivity of VAT relative to income (annual income and lifetime income) and causes VAT to be mildly progressive relative to consumption.

Distributional characteristics of the indirect tax system in Greece are analysed in Kaplanoglou and Newbery (2003) and Kaplanoglou (2015). Kaplanoglou und Newbery (2003) aim to assess whether existing differentiated tax rates are justified from a welfare point and, therefore, examine whether the aggregate marginal indirect tax rate varies across income distribution. The results show that marginal indirect tax rates do not really vary across income (or expenditure) distribution, when household characteristics is controlled for. A reason might be that the consumption patterns are not differentiated enough. Therefore, differentiated indirect tax rates lead, at most, to redistribution of income between different household types at each income level. Based on five

[19] Decoster et al. (2010) also disprove that regressivity of indirect taxes regarding the income distribution is due to excises only.

waves of HES data, Kaplanoglou (2015) analyses how the redistributive effect of indirect taxes in Greece evolved over the years 1988–2011. This is especially interesting as the indirect tax system was largely simplified and indirect taxes largely increased during this period. The indirect tax burden overall as well as that of various commodity groups are measured as percentages of expenditures per expenditure decile and displayed for each wave. Further, several inequality measures (Gini, Atkinson and Theil index) for the respective indirect tax system in each wave are calculated and compared with the corresponding indices stemming from simulated indirect tax systems. According to the results, the simplification of the indirect Greece tax system did not cause considerably adverse distributional effects. However, the recent indirect tax hikes had adverse distributional effects: households were not equally affected due to differences in their consumption patterns and different degrees of substitutions of consumption away from commodities with high taxation.

For Ireland, Barrett and Wall (2006) and Leahy, Lyons and Tol (2011) analyse the redistributive effect of the indirect tax system. Based on 1999/2000 HBS data, Barrett and Wall (2006) find that indirect taxes in Ireland are regressive (measured in percentage of income per income decile). They would even be more regressive without the existing tax exemption of food. Interestingly, in relative terms, the lower VAT rate (of 13.5%) is more regressive than the higher VAT rate (of 21%).[20] Also Leahy, Lyons und Tol (2011) find that the current Irish VAT system is regressive, based on 2004/2005 HBS data.[21] Further, a VAT increase as well as a flat rate would have the worst (proportional) effect on the poorest households and also an increase of reduced (zero) VAT rates on food and children's clothing would cause a regressive effect. On the contrary, a zero rating of tobacco and alcohol would reduce the regressivity of the VAT system.

VAT analyses for the Czech Republic, both based on HBS data, can be found in Klazar (2008) and Slintáková and Klazar (2010). Klazar (2008) differentiates between measuring the effective tax rate in an annual and a lifetime context. Whereas in the former framework, the tax burden is measured relative to gross income over the income distribution, in the latter, it is measured

[20]The lowest income decile spends almost three times the percentage of gross household income on VAT at the rate of 13.5 percent compared to the highest decile. However, for VAT at the rate of 21%, it is 'only' about twice the percentage.

[21]The VAT burden is measured relative to disposable income across equivalised income deciles and across households of different composition and different sizes.

relative to gross consumption expenditures over the expenditure distribution. According to the results, VAT is regressive in an annual context and progressive in a lifetime context, whereas the former effect is due to the higher consumption propensities of poor households.[22] Slintáková and Klazar (2010) also measure VAT progressivity for the Czech Republic in an annual and in a lifetime framework. In the former framework, economic well-being is measured and households ranked by gross income and in the latter by gross expenditures. Income inequality is measured by generalised entropy measures and the Gini index and the VAT burden distribution by the relative VAT burden per decile and the Thin-Musgrave index. Slintakova und Klazar (2010) conclude that VAT is regressive in an annual context due to the higher consumption propensity of lower income households. However, in the lifetime context, the consumption structure makes VAT progressive.[23] The results also reveal that post-tax income distribution was more equally distributed before VAT harmonisation in 2004 than after.

Based on HES data, Braz and da Cunha (2009) analyse distributional aspects of VAT for Portugal. By analysing the consumption patterns of expenditures subject to VAT, Braz and da Cunha (2009) conclude that goods and services are not exclusively exempt from being taxed or taxed with a reduced rate for distributional reasons.[24] Further, they find a positive relation between (the decile of) equivalent adult net income and the VAT burden, measured relative to expenditures (net of VAT) (except the first decile). However, the relation between (the decile of) equivalent adult net income and the VAT burden, measured relative to net income, is negative (with proportionality between some deciles), due to a consumption propensity that decreases with income. Measuring the overall redistributive VAT effect regarding expenditures with the Reynolds-Smolensky index reveals that expenditures inequality increase statistically significantly due to VAT. Moreover, this overall distributional VAT effect is decomposed into a vertical, horizontal and reranking component.[25]

[22] Klazar (2008) also evaluates, for both frameworks, whether the average effective VAT rates of adjacent quintiles differ statistically significantly from each other.

[23] The consumption structure is analysed by displaying expenditure share by VAT rate for each income decile.

[24] The average expenditures for various classes of goods and services subject to VAT as percentage of overall expenditures and a breakdown of the expenditures (net of VAT) by VAT rates are both illustrated for each decile of equivalent adult net income.

[25] This decomposition enables potential vertical and horizontal inequity to be measured. See Aronson, Johnson and Lambert (1994), Lambert and Ramos (1997), Urban and Lambert (2005; 2008) and van de Ven, Creedy and Lambert (2001) for approaches to decompose the redistributive effect of taxes into different components. See Creedy (2002) and Kaplanoglou and Newbery (2008) as examples of decomposing the redistributive effect of indirect taxes

2.2 Literature on Switzerland

The first study regarding the redistributive effect of VAT in Switzerland was carried out by Mottu (1997). Mottu (1997) bases his VAT analysis on data from the Consumer Expenditure Survey 1990, therefore on data collected before the introduction of VAT in 1995. Based on the Lorenz curve and the Gini coefficient, Mottu (1997) measures the progression and distributional effect of VAT and direct federal tax. Mottu finds that direct federal tax is about three times as progressive as VAT is regressive. Hence, according to Mottu (1997), an increase of VAT rates to 15 and 5 percent (normal and reduced rate) results in an approximately proportional overall effect of VAT and direct federal tax together on income distribution.

The Swiss Federal Council bases their conclusion about the distributional effect of VAT on Mottu's study (1997) in their report on improvements to VAT. They conclude that VAT is slightly regressive in relation to income, slightly progressive in relation to consumption and overall does not cause large redistribution in Switzerland (Bundesrat, 2005, p. 62 ff.).[26]

Ecoplan (2006) analyses the growths and (intergenerational, intragenerational and functional) distributional effects of three VAT reforms[27] using a dynamic model of growth (overlapping generation model). According to the results of Ecoplan (2006), the reforms do not generally affect poor households, but the overall economic welfare gains are especially unequally distributed between the generations: Welfare losses are expected for older households, whereas younger households might benefit from the reforms.

The Federal Department of Finance (FDF) analyses various distributional effects of VAT, based on the Household Budget Survey (HBS) 2000-2002, as part of the consultation proposal to simplify federal law on VAT (MWSTG). They find, for example, that lower income groups are, by percentage, more disburdened than higher income groups due to the reduced tax rate on food and non-alcoholic beverages, but the reverse is true in absolute terms. However, this effect is primarily due to different numbers of persons per household.[28] Further, the FDF calculates the

into different components.

[26] Further, it is assumed that a revenue-neutral flat rate would be between 5 and 6 percent, given that a substantial part of all tax exemptions would be taxed under the flat rate regime.

[27] One reform includes a revenue neutral flat rate of 6 percent, beside the abolition of tax exemptions.

[28] Based on HBS data 2003-2005, the SFAO confirms that the highest income quintile benefits more in absolute terms (twice as much) from the reduced VAT rate on food than the lowest income quintile. However, the expenditures per capita for food and non-alcoholic beverages are almost equal in the highest and lowest income quintile,

effect of several VAT reforms on the VAT burden of different income groups and household types as well as, for some household types, the effects of two of these VAT reforms on various spending categories.[29] Calculation, which is based on the status quo, of the VAT burden relative to income per income quintile reveals that VAT is regressive (Eidgenössisches Finanzdepartment EFD, 2007, p. 40 ff.; 162 ff.).

In the note of the Swiss Federal Council to simplify VAT, a VAT reform in two parts A and B is presented, and the distributional analyses of the FDF (see Eidgenössische Finanzdeparment EFD, 2007), based on HBS data 2003-2005, are replicated for Part B.[30] Part B includes a flat rate of 6 percent, or rather 6.1 percent taking a social-political corrective[31] into account, as well as the abolition of some exemptions. Neglecting the social-political corrective leads to an increased VAT burden for all income classes. However, the effects vary between household types[32] (Eidgenössische Steuerverwaltung ESTV, 2008, p. 7094 ff.). Due to the rejection of Part B of the VAT reform, the Swiss Federal Council wrote up an additional note on the simplification of VAT (two-rate model).[33] The effects of this two-rate model on the VAT burden of private households per household type and income quintile are calculated based on HBS data 2006-2009 (Eidgenössische Steuerverwaltung ESTV, 2013).

Kaderli (2015) more or less replicates an OECD-study (see OECD/Korea Institute of Public Finance, 2014) and calculates the VAT burden per household for each income quintile and five different household types, based on aggregated HBS data 2006-2008 and 2009-2011. Measuring the VAT burden relative to expenditures results in a proportional or slightly progressive VAT system whereas relative to disposable income, a regressive VAT system results. Kaderli (2015) also calculates a revenue-neutral uniform VAT rate and simulates the distributional effects caused

whereas middle class households spend less (Eidgenössische Finanzkontrolle EFK, 2007). The findings that lower income classes are by percentage and the higher income classes in absolute terms disburdened by the reduced tax rates on food are also confirmed in a paper of the FTA, again based on HBS data 2003-2005 (Eidgenössische Steuerverwaltung ESTV, 2008, p. 7051 f.).

[29] Essentially, four VAT reforms are considered (three modules and one variant). One module includes the abolition of many tax exemptions and a revenue-neutral flat rate of 6 percent. This reform can put additional financial burden on domestic households, because in the status quo, VAT is exported.

[30] For the minor effects on a household's VAT burden caused by part A of the VAT reform, see Section 3.4 in the original paper. In the status quo analysis, the measured VAT burden is still regressive relative to income.

[31] The aim of the social-political corrective is that the two lowest income classes are financially not worse off with than without the reform.

[32] Families with children and pensioner households in particular must expect a noticeably higher VAT burden. Profiteers would be a part of the single households.

[33] It includes: a two-rate structure, retaining most exemptions, the abolition of the special rate, and two variants on which goods and services the reduced rate should apply to.

by the introduction of a uniform VAT rate.

3. Measuring inequality, progression and distributional effects

Tax burdens across households are most commonly represented through tabular representation of, for example, the ratio of tax to income, whereby households are divided into quantiles (deciles, quintiles, etc.). Inequality is often measured using single number measures. They are mostly based on the Lorenz curve,[34] but can also be based on generalised entropy measures (Warren, 2008). We will use both tabular representation and measures based on Lorenz curves and concentration curves.[35] Musgrave and Thin (1948) proposed to measure *effective progression* based on the Gini coefficient by using the ratio of post-tax Gini (G_{X-T}) and pre-tax Gini (G_X):[36] $P^{MT} = \frac{1-G_{X-T}}{1-G_X}$. Kakwani (1977a) argues that the measure proposed by Musgrave and Thin (P^{MT}) is not a suitable measure of progressivity, but is actually a measure for the distributional effect of taxes. Kakwani (1977a) proposes measuring tax progressivity (P^K) by comparing the pre-tax income Lorenz curve with the tax concentration curve or more precisely, the corresponding Gini coefficient (G_X) with the corresponding concentration coefficient (C_T): $P^K = C_T - G_X$.

A related measure of progressivity is proposed by Suits (1977). He constructs a concentration curve by plotting the accumulated percentages of total tax burden against the accumulated percentages of total pre-tax income. The Suits index is calculated as $P^S = 1 - \frac{L}{K}$; where K corresponds to the area under the line given a proportional tax distribution and L to the area under the constructed concentration curve.

Reynolds and Smolensky (1977a, p. 66 f.)[37] calculate Gini coefficients for different distributive

[34] The Lorenz curve concept relates the relative cumulative population shares to the relative cumulative income shares, ordered by income size. This enables conclusions as to which share of the population disposes of which share of the overall income. The Gini coefficient is based on the Lorenz curve and is equivalent to the following ratio: area between the diagonal and the Lorenz curve divided by the total area under the diagonal. The Gini coefficient varies between 0 and 1 (see, p.e., Bundesrat 2014, p. 35 f.).

[35] "The generalized Lorenz curves are called concentration curves and the Lorenz curve is only a special case of such curves, viz, the concentration curve for income" (Kakwani, 1977b, p. 719). Moreover, concentration curves and coefficients can be calculated and constructed in analogy to Lorenz curves and Gini coefficients, but the ordering of the analysed units might vary (Lambert, 2001, p. 40 f.). For clarity, we also refer to concentration coefficients based on expenditures as Gini coefficients provided that the ordering is by size. This allows us to use the term concentration coefficient explicitly in cases where the ordering of the analysed units is varied, i.e. ranking not by size.

[36] For clarity, we always refer to pre-tax by X and to post-tax by X-T, independent of the notation in the original paper.

[37] Later also published in Reynolds and Smolensky (1977b).

experiments and compare these post-tax experiment Gini coefficients with the corresponding pre-tax Gini coefficients in order to measure redistribution. This measure of the redistributive effect of taxes is known as the Reynolds and Smolensky index. It is worth mentioning that the statements in Reynolds and Smolensky (1977a) do not allow a final assessment as to whether possible reranking was considered. Therefore, the definition of the Reynolds and Smolensky index differs in the literature: $R^{RS} = G_X - G_{X-T}$ (see, e.g., Kesselman and Cheung, 2004, or Warren, 2008) vs. $R^{RS} = G_X - C_{X-T}$ (see, e.g., Peichl and Schaefer, 2008). For simplicity, we refer to the difference between the pre- and post-tax Gini as the redistributive effect $RE = G_X - G_{X-T}$.

Kakwani (1977a) outlines the important and useful relation that the difference between the pre- and post-tax Gini coefficients (i.e. the redistributive effect RE) depends on the Kakwani progressivity measure (P^K) and the average tax rate (t): $G_X - G_{X-T} = \frac{tP^K}{(1-t)}$.[38]

If pre-tax ranking of income units differs from their ranking by taxes, the order of the income units might change due to taxation. This important finding in the analysis of the distributional effect of taxation goes back to contributions by Atkinson (1980), Plotnick (1981) and Kakwani (1984) and is therefore known as the Atkinson-Plotnick-Kakwani (R^{APK}) reranking index.[39] R^{APK} measures the difference between the post-tax income Gini coefficient (ranking by post-tax income) and the post-tax income concentration coefficient (ranking by pre-tax income): $R^{APK} = G_{X-T} - C_{X-T}$. Further, Kakwani (1984) outlines that the total redistributive effect of taxation RE can be decomposed into a vertical and a horizontal component:[40]

$$RE = G_X - G_{X-T} = \frac{tP^K}{(1-t)} + (C_{X-T} - G_{X-T}) \tag{1}$$

The vertical component $\frac{tP^K}{(1-t)}$ can also be written as $G_X - C_{X-T}$ (see Footnote 38) and the horizontal component corresponds to the reranking component R^{APK} (see above).

[38] If the possibility of reranking income units due to the taxation process is taken into account, this relation changes (see below, i. a. Equation 1, for further information). In this case, the difference between the pre-tax Gini coefficient (G_X) and the post-tax concentration coefficient (C_{X-T}) (ordering according to pre-tax income) depends on the Kakwani progressivity measure (P^K) and the average tax rate (t): $G_X - C_{X-T} = \frac{tP^K}{(1-t)}$ (Urban, 2009, for example, outlines this relation).

[39] See, e.g., Monti, Vernizzi and Mussini (2010) or Urban and Lambert (2008). Sometimes, it is also referred to as simply Atkinson-Plotnick reranking index (R^{AP}) (see, e.g. Aronson, Johnson, and Lambert, 1994).

[40] Notation adjusted, vs. the original paper, to be consistent in our paper.

4. Methodology

The fact that VAT is a consumption tax makes the measurement of the VAT burden per household or at an individual level less straightforward than for income or asset tax, where tax returns can be used. A database must be found that represents consumption at household or individual level as comprehensively and detailed as possible. Moreover, the data must include socio-economic information at household and/or individual level. This allows the VAT burden to be calculated at household or individual level and to be related to socio-economic characteristics.

4.1 Data

For the analyses, we use data from the Swiss Household Budget Survey 'Haushaltsbudgeterhebung' (HABE) for the years 2009 to 2011, compiled by the Swiss Federal Statistical Office.[41] The HABE is an appropriate data set as it aims to capture in detail the household budgets of the Swiss residential population. For this purpose, participating households note all their expenditures and incomes during one month (Bundesamt für Statistik BFS, a). The survey period might be varied for some goods depending on the frequency of purchase. Finally, all outcomes in the HABE data are stated in Swiss Francs per month and household (Bundesamt für Statistik BFS, 2013). Further, the HABE includes household details such as the size and type of households and socio-economic information relating to the reference persons (Bundesamt für Statistik BFS, b). Therefore, the HABE data is more appropriate than any other available data for calculating and analysing the VAT burden at household level.[42/43]

To ensure adequate representation of the Swiss residential population, the collected survey data should be weighted (Bundesamt für Statistik BFS, 2007). Therefore, all forthcoming analyses in this paper will be based on weighted data.[44] Further, the weighting method enables survey data to be pooled over several years. In this way, the sample size can be increased and population groups of small numerical size can be analysed (Bundesamt für Statistik BFS, 2007). We pool the

[41] Data source: 'Bundesamt für Statistik, Haushaltbudgeterhebung (HABE) 2009 bis 2011'.

[42] Nevertheless, as, for example the OECD/Korea Institute of Public Finance (2014, p. 27 f.) states, the VAT revenues which are calculated based on household budget surveys mostly underestimate the effective revenues, outlining various reasons for the underestimation.

[43] Household budget data does not allow the VAT burden of foreigners in Switzerland or of Swiss abroad to be calculated.

[44] The weighting is calculated by the Federal Statistical Office (Bundesamt für Statistik BFS, b).

years 2009 to 2011 (henceforth HABE data 2009-2011).[45]

4.2 Simulation

An important choice to be made is whether to measure the VAT burden relative to income or relative to expenditures.[46] The choice for one or the other approach might be decisive in the context of evaluating the redistributive VAT effect and its driver since the saving rate is not reflected when measuring the VAT burden relative to expenditures (see also Sections 2 and 5).[47] A consideration in this context might also be to decide whether welfare should be measured through current income or consumption expenditures (possibly as a proxy for lifetime income[48]). The decision to measure the VAT burden relative to income or expenditures is also closely connected to the question of how to measure and tax individual performance capability. There are two opinions in this context regarding tax fairness (Homburg, 2010, p. 202):

- advocates of tax on consumption argue that individual performance must be measured by periodical consumption: satisfaction of needs by consumption.
- advocates of taxation on income argue that individual performance is reflected by income: satisfaction of needs by savings, thus potential consumption.

According to Homburg (2010, p. 223), whether fiscal performance capability should be measured by consumption or income cannot be decided scientifically. We consider both arguments and measure the VAT burden relative to income and to expenditures. This allows us to illustrate the importance of this decision to evaluate the redistributive VAT effect overall and the redistributive effect of differentiated VAT rates in particular. As the OECD/Korea Institute of Public Finance

[45] See https://www.bfs.admin.ch/bfs/de/home/statistiken/wirtschaftliche-soziale-situation-bevoelkerung/erhebungen/habe.html for further information regarding HABE.

[46] See, for example, OECD/Korea Institute of Public Finance (2014, p. 30 ff.) or Warren (2008), outlining the importance of this decision and for further information regarding this topic such as a listing of different papers applying one or the other approach.

[47] But as Metcalf (1995) states, it can also be argued that a proportional broad-based consumption tax becomes proportional over lifetime as, without bequests, the (present value of) consumption over lifetime equals the (present value of) lifetime income. However, VAT is implicitly also levied on bequests as recipients are subject to VAT as soon as they are consumed.

[48] According to Decoster et al. (2010) and Warren (2008), the annual consumption can be used as a proxy for lifetime income. It is argued that consumption depends on the individual lifetime income. Hence, consumption is less volatile than annual income, viz. consumption is relatively stable over the life cycle. However, according to Morelli, Smeeding and Thompson (2014) there is only limited proportionality between consumption and permanent income. For this reason, Morelli, Smeeding and Thompson (2014) do not consider actual consumption a good proxy for permanent income.

(2014, p. 30 ff.) outlines, another decision to be made is whether to measure the tax burden across income or expenditure distribution. However, when measuring inequality with the Gini coefficient, this question is not of relevance since the units should be ordered by size. Therefore, if we measure the VAT burden relative to income, we use income distribution and when we measure the VAT burden relative to expenditures, we use expenditure distribution.

We calculate the absolute VAT burden per household by applying the appropriate VAT rate (see Table 1 for the VAT rates over time) on all consumption expenditures in the HABE data.[49/50] The VAT rate assignment is carried out at a detailed expenditure level (far more detailed than the main categories listed in Footnote 49).[51] As we can see in Table 1, a VAT rate change occurs during our analysed period. We apply the rates in place as of 1^{st} January 2001 for the whole sample period.[52]

To measure the relative VAT burden, the calculated absolute VAT burden is put in relation to consumption expenditures excluding VAT or gross income. Hence, we follow the recommendations of Barrett and Wall (2006) and Braz and da Cunha (2009) and use gross income as an income measure. This allows us to assess whether taxation of consumption increases or decreases the progression effect of income tax. Further, the use of gross income improves comparability. Because, as Kaderli (2015) argues, changes in the tax system might change the results when the VAT burden is measured relative to disposable income.

The absolute VAT burden, expenditure and income figures per household are converted into need-adjusted figures by use of a (modified) OECD equivalence scale.[53]. As can be seen in Leahy,

[49]The following main categories are considered according to HABE classification: 'food and non-alcoholic beverages'; 'alcoholic beverages and tobacco goods'; 'restaurants and accommodation'; 'clothing and footwear'; 'housing and energy'; 'furnishing and housekeeping'; 'healthcare'; 'transportation'; 'communication'; 'entertainment, recreation and culture'; 'school and educational fees'; 'other goods and services'; 'gifts and invitations' (category created by the author because the expenditures 'regular gifts to other households' and 'gifts and invitations' are listed in HABE in the main categories 'monetary transfer expenditures to other households' and 'other insurances, fees and transfers', which are not part of our consumption expenditures).
The following main categories are excluded from our analyses: 'compulsory transfer expenditures', 'monetary transfer expenditures to other households' (except for the subcategory 'regular gifts to other households'; see above) and 'other insurances, fees and transfers' (except for the subcategory 'gifts and invitations'; see above), although some minor VAT revenue may be due to expenditures included in 'other insurances, fees and transfers'.

[50]This approach is based on the standard assumption that VAT is fully shifted to consumer prices (see, for example, IHS, 2011, for a discussion of the related literature).

[51]But even at a detailed level no straightforward rate allocation is possible for some categories.

[52]VAT exempted goods and services are simulated as taxed at zero rate.

[53]The OECD equivalence scale applies the following weights: 1,0 for the first adult; 0,5 for persons of 14 years or older; 0,3 for children younger than 14 years. The equivalence scale must be slightly modified because of the available data in the HABE: instead of the age of 14 we use the age of 15 to differentiate between use of the factor 0.3 or 0.5.

Lyons and Tol (2011), the use of an equivalence scale enables households of different composition and size to be compared. Households with negative disposable income are excluded from the analyses to ensure sensible calculations.

Table 1
VAT rates over time

	rate		
	normal	reduced	special
1 January 2011 - VAT rates increase for the benefit of disability insurance	8.0%	2.5%	3.8%
1 January 2001 - VAT rates increase for financing large-scale railway projects - introduction VAT law	7.6%	2.4%	3.6%
1 January 1999 - VAT rates increase for the benefit of Old Age and Survivors' Insurance and the disability insurance	7.5%	2.3%	3.5%
1 October 1996 - introduction special rate accommodation	6.5%	2.0%	3.0%
1 January 1995 - VAT decree	6.5%	2.0%	

Source: Eidgenössiche Steuerverwaltung ESTV, a.

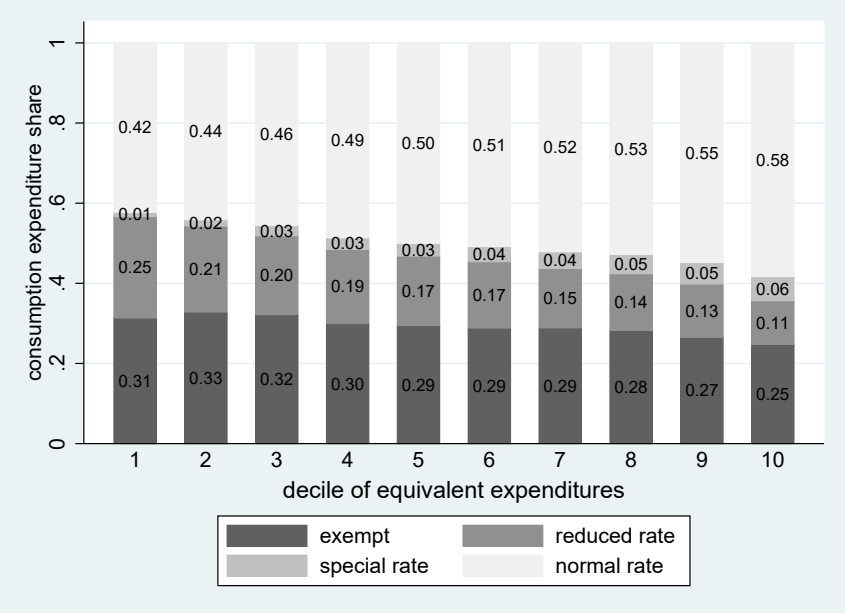
5. Relation of consumption pattern, saving rate and average VAT burden per decile of equivalised income or expenditures

We evaluate the argument to differentiate VAT rates for distributional reasons (see Section 1) by breaking down household consumption expenditures by VAT rate and across decile of equivalised expenditures. As can be seen in Figure 1, expenditure shares exempted from VAT or taxed at the reduced rate decrease with the decile of equivalised expenditures. Therefore, the current VAT rate structure taxes consumption expenditures in the higher deciles of equivalised expenditures more, on average, than those of the lower deciles. This indicates that at least some of the intended distributional impact might be achieved by the currently valid VAT rate differentiation.[54]

As a consequence of the higher average taxation of consumption expenditures in the higher

[54] An expenditure breakdown by VAT rate and across deciles of equivalised income results in a very similar picture.

Figure 1
Consumption expenditures breakdown by VAT rate and per decile of equivalised expenditures



Source: Own calculation and illustration based on weighted HABE data 2009-2011.

deciles of equivalised expenditures (see Figure 1), the average VAT burden per decile of equivalised expenditures, which is measured relative to expenditures, increases for higher deciles. The upper chart in Figure 2 illustrates this finding and Table 2 tabulates the average VAT burden per decile of equivalised expenditures, measured relative to expenditures, its standard errors and the corresponding 95 percent confidence intervals. Further, we find that the average VAT burden between 5 out of 9 adjacent deciles of equivalised expenditures differ statistically significantly from each other (see the column 't-value difference' in Table 2).[55/56]

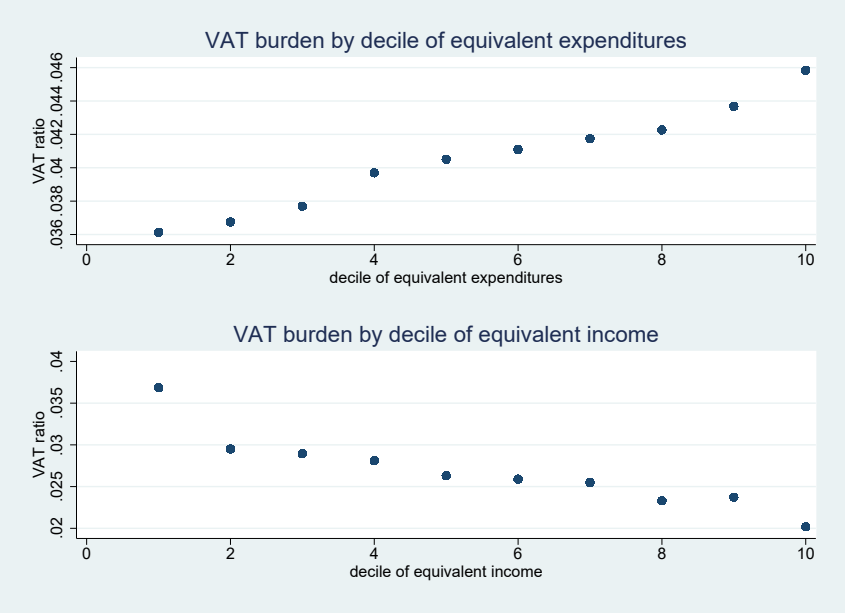
A comparison of the upper and lower charts in Figure 2 illustrates unambiguously that the redistributive effect of VAT changes considerably when the VAT burden is measured relative to income and per decile of equivalised income: the average VAT burden per decile of equivalised income, measured relative to income, decreases with increasing deciles (see also Table 3).[57] The only exception is between the 8$^{\text{th}}$ and 9$^{\text{th}}$ decile of equivalised income where the VAT burden

[55] When splitting the population into quintiles of equivalised expenditures, the average VAT burdens between all adjacent quintiles of equivalised expenditures differ statistically significantly from each other.

[56] The finding that the VAT burden, measured relative to expenditures, increases with expenditures is supported by a simple regression of the VAT burden, measured relative to consumption expenditures, on equivalised consumption expenditures: the coefficient on the independent variable *equivalised consumption expenditures* is statistically significantly positive.

[57] The finding that the VAT burden, measured relative to income, decreases with income is supported by a simple regression of the VAT burden, measured relative to income, on equivalised gross income: the coefficient on the independent variable *equivalised gross income* is statistically significantly negative.

Figure 2
Average VAT burden by decile of equivalised expenditures and equivalised income



Notes: In the upper chart, the VAT burden is measured relative to expenditures and in the lower chart relative to income.
Source: Own calculation and illustration based on weighted HABE data 2009-2011.

Table 2
Average VAT burden, measured relative to expenditures, by decile of equivalised expenditures

decile of eq. expenditures	average VAT burden	standard error	95% confidence interval		t-value difference[a]
			lower bound	upper bound	
1^{st}	.0361	.000381	.0354	.0369	–
2^{nd}	.0368	.000318	.0361	.0374	1.25
3^{rd}	.0377	.000297	.0371	.0383	2.15*
4^{th}	.0397	.000305	.0391	.0403	4.7**
5^{th}	.0405	.000291	.0399	.0411	1.92+
6^{th}	.0411	.000288	.0405	.0417	1.44
7^{th}	.0417	.000299	.0412	.0423	1.56
8^{th}	.0423	.000276	.0417	.0428	1.28
9^{th}	.0437	.000283	.0431	.0442	3.56**
10^{th}	.0458	.000313	.0452	.0464	5.12**

Notes: + p<.10, * p<.05, ** p<.01. eq.=equivalised. [a] t-value difference: shows the t-values of testing whether the average VAT burden of a decile of equivalised expenditures differs from the adjacent lower decile.
Source: Own calculation based on weighted HABE data 2009-2011.

slightly increases, but not statistically significantly.[58]

The transition from measuring the VAT burden relative to expenditures by decile of equivalised expenditure to measuring the VAT burden relative to income by decile of equivalised income includes two steps:

[58]See Table 3, column t-value difference, as to whether the deciles of equivalised income differ statistically significantly from the adjacent deciles. Again, splitting the population into quintiles instead of deciles has the effect that the average VAT burden of all adjacent quintiles of equivalised income differ significantly from each other.

Table 3
Average VAT burden, measured relative to income, by decile of equivalised income

decile of eq. income	average VAT burden	standard error	95% confidence interval		t-value difference[a]
			lower bound	upper bound	
1^{st}	.0369	.000976	.0349	.0388	.
2^{nd}	.0295	.000556	.0284	.0306	-6.54**
3^{rd}	.0289	.000571	.0278	.0301	-.705
4^{th}	.0281	.00055	.027	.0292	-1.04
5^{th}	.0263	.000424	.0255	.0271	-2.61**
6^{th}	.0259	.000426	.0251	.0267	-.697
7^{th}	.0255	.000488	.0245	.0264	-.632
8^{th}	.0233	.000358	.0226	.024	-3.61**
9^{th}	.0237	.000383	.023	.0245	.818
10^{th}	.0202	.000355	.0195	.0209	-6.77**

Notes: + p<.10, * p<.05, ** p<.01. eq.=equivalised. [a] t-value difference: shows the t-values of testing whether the average VAT burden of a decile of equivalised income differs from the adjacent lower decile.
Source: Own calculation based on weighted HABE data 2009-2011.

1. measuring the VAT burden across income distribution instead of expenditure distribution

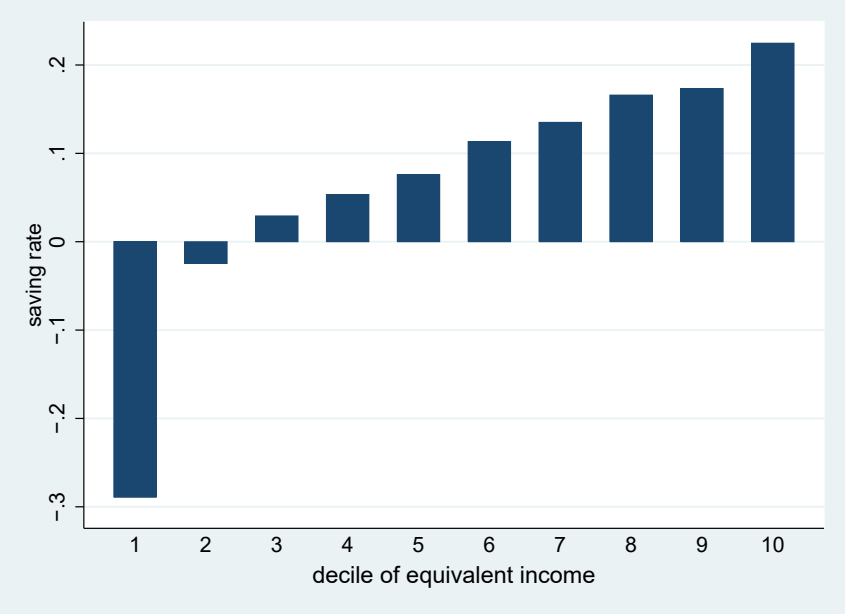
2. measuring the VAT burden relative to income instead of relative to expenditure

In the first step, households with a high saving rate are ranked higher in income compared to expenditure distribution. This leads to only minor changes in the VAT burden per decile (with the exception of the 10^{th} decile): The relative VAT burden of the lower deciles increases whereas the higher deciles are relatively disburdened when the relative VAT burden is measured over income instead of expenditure distribution. Figure 6 in the Appendix illustrates this shift of the tax burden. The second step is much more important regarding the distribution of the VAT burden. Measuring the VAT burden relative to income instead of relative to expenditure changes the VAT impact from being progressive (the higher deciles are percentally more heavily taxed than the lower deciles) to being regressive (the higher deciles are percentally less heavily taxed than the lower deciles). The reason for this changing progression effect can be found in the saving rate. It is evident in Figure 3 that the average saving rate increases with decile of equivalised income. In fact, the two lowest deciles even dissave. These different saving rates in the deciles of equivalised income result in a regressive impact of VAT if the VAT burden is measured relative to income and across income distribution.[59] Therefore, based on analysing the redistributive VAT effect per decile, we can conclude that differentiated VAT rates and tax exemptions have some

[59]See Table 11 in the Appendix tabling, analogous to Tables 2 and 3, the average saving rates per decile of equivalised income, its standard errors and the corresponding 95 percent confidence intervals as well as the t-values from testing whether the average saving rate per decile of equivalised income differs from the adjacent lower decile.

intended distributional effect, but are not able to compensate the effect of the saving rate on the redistributive VAT effect regarding income distribution.

Figure 3
Average saving rate by decile of equivalised income



Source: Own calculation and illustration based on weighted HABE data 2009-2011.

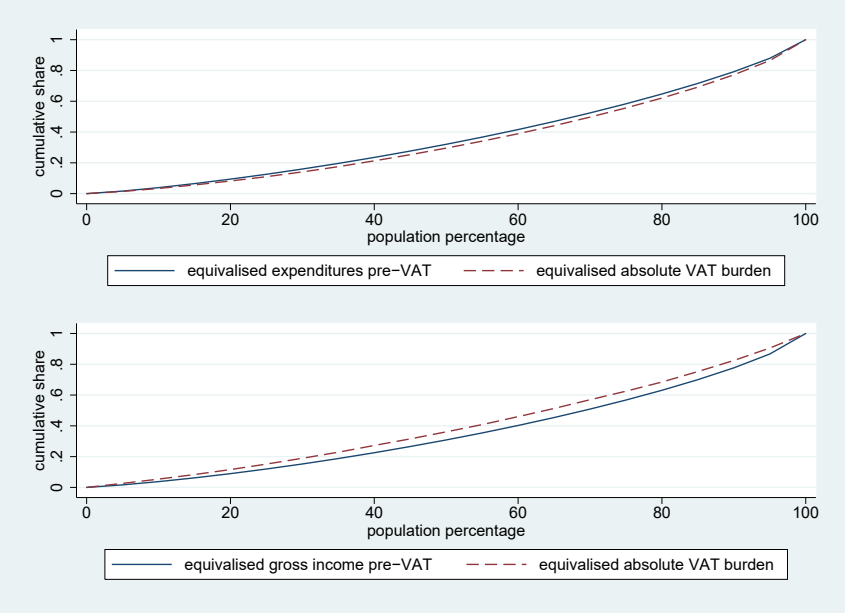
6. Redistributive VAT effect measured based on the Gini coefficient

In this section, we measure the redistributive VAT effect (RE) by comparing the pre-tax Gini coefficient with the post-tax Gini coefficient.[60] This enables the overall redistributive VAT effect to be evaluated as well as the impact of different consumption patterns combined with differentiated VAT rates and tax exemptions and of different consumption propensities on the expenditure and income Gini coefficient.

The concentration curves of the equivalised VAT burden (ordered by equivalised pre-VAT expenditures) and equivalised pre-VAT expenditures in the upper chart of Figure 4 illustrate that the VAT burden is more unequally distributed than the expenditures. Accordingly, the Gini coefficient calculated on the equivalised consumption expenditures pre-VAT is smaller than the Gini coefficient calculated on the expenditures including VAT, see Table 4. This means that households with higher equivalised expenditures might pay more VAT relative to their expenditures. A result

[60] See Section 3 for information regarding the Reynolds and Smolensky index.

Figure 4
VAT burden concentration curve vs. expenditures concentration curve and income Lorenz curve



Notes: y-axis upper chart: cumulative expenditures and VAT share. y-axis lower chart: cumulative gross income and VAT share. x-axis upper chart: population percentage ordered by equivalised expenditures pre-VAT. x-axis lower chart: population percentage ordered by equivalised gross income pre-VAT.
Source: Own calculation and illustration based on weighted HABE data 2009-2011.

which is in line with our finding from Section 5 that VAT rate differentiation and tax exemptions causes at least some progressive distributional effects regarding expenditure distribution. However, comparing the concentration curve of the equivalised VAT burden (ordered by equivalised gross income) with the Lorenz curve of the equivalised gross income (see the lower chart in Figure 4) we find that the VAT burden is more equally distributed than the equivalised pre-tax (gross) income. Therefore, the Gini coefficient based on equivalised pre-tax gross income is smaller than the Gini coefficient based on equivalised gross income after deducting VAT, see Table 4, and VAT might increase (post-VAT) income inequality. Again a result in accordance with the findings in Section 5. However, neither the difference between the pre- and post-VAT expenditure nor income Gini coefficient is statistically significant: based on the Gini coefficient, VAT does not cause any statistically significant redistribution (regarding income and expenditure distributions). As a consequence, based on the Gini coefficient, we cannot confirm our findings from Section 5 that differentiated VAT rates and tax exemptions, combined with different consumption patterns between households, cause a progressive VAT effect regarding expenditures distribution and that different consumption propensities between households change this impact to being regressive regarding

income distribution.

Table 4
Redistributive VAT effect measured based on the Gini coefficient

	Gini coefficient		RE
	pre-VAT	post-VAT	
equivalised expenditures	0.25930	0.26091	-0.00161
	(0.00248)	(0.00248)	
equivalised income	0.27910	0.28127	-0.00218
	(0.00283)	(0.00286)	

Notes: + p<.10, * p<.05, ** p<.01. Standard errors in parentheses. RE = Gini coefficient pre-VAT − Gini coefficient post-VAT.
Source: Own calculation based on weighted HABE data 2009-2011.

7. Simulation of three VAT scenarios

In the following, we simulate three different VAT scenarios: a flat rate of 6.25 percent, a flat rate of 15 percent and a tripling of the current VAT rates.[61] The flat rate of 6.25 percent is chosen because it ensures approximately the same VAT revenue as to date:[62/63] a comparison of the redistributive VAT effect of a VAT system with differentiated VAT rates with that of a revenue-neutral flat rate permits an evaluation of the impact of differentiated VAT rates on redistribution, while keeping VAT revenues constant. The two other scenarios make it possible to analyse whether our measured effects change with increasing VAT: a rate of 15 percent corresponds to the minimal standard rate in the European Union[64] and after tripling the VAT rates,[65] they are at approximately the same level as in surrounding countries.[66]

Table 5 displays the redistributive effect of all three reforms on the Gini coefficients. As expected, a flat rate (of either 6.25 or 15 percent) causes only minor redistributive effects on expenditure distribution: the Gini coefficients based on equivalised consumption expenditures pre- and post-VAT do not statistically differ. Further, we cannot identify a significant redistributive

[61] In all three simulations, we assume that consumption patterns, pre-VAT consumption expenditures and tax exemptions/assessment basis are stable compared to the status quo.
[62] Revenue-neutral flat rates for Switzerland are also calculated in Bundesrat (2005, p. 65), Ecoplan (2006), Eidgenössisches Finanzdepartment EFD (2007, p. 165), Eidgenössische Steuerverwaltung ESTV (2008, pp. 6888/7072) and Kaderli (2015) (see Section 2).
[63] Possible shifts of tax burden between households and non-households or changes in exported VAT are not considered.
[64] See Article 97 in the Council Directive 2006/112/EC of 28 November 2006 on the common system of value added tax; http://eur-lex.europa.eu/eli/dir/2006/112/oj.
[65] The VAT rates effective as of 1^{st} January 2001 are tripled.
[66] See https://ec.europa.eu/taxation_customs/business/vat/eu-vat-rules-topic/vat-rates_de.

effect of the flat rate of 6.25 percent on income distribution. However, a flat rate of 15 percent has a significant regressive effect on income distribution: the Gini coefficient based on equivalised gross income is statistically significantly smaller pre- than post-VAT. After tripling the VAT rates, the redistributive VAT effect on the Gini coefficient is significant regarding both expenditure and income distribution: equivalised consumption expenditures and equivalised gross income are statistically significantly more equally distributed pre- than post-VAT. Therefore, after tripling the VAT rates, VAT has a progressive effect on expenditure distribution and a regressive effect on income distribution.

Table 5
Redistributive effect of three VAT simulations: a flat rate of 6.25 percent, a flat rate of 15 percent and a tripling of the VAT rates

	Gini coefficient		RE
	pre-VAT	post-VAT	
flat rate of 6.25 percent			
equivalised expenditures	0.25930	0.26005	-0.00074
	(0.00248)	(0.00247)	
equivalised gross income	0.27910	0.28172	-0.00262
	(0.00283)	(0.00287)	
flat rate of 15 percent			
equivalised expenditures	0.25930	0.26108	-0.00178
	(0.00248)	(0.00246)	
equivalised gross income	0.27910	0.28591	-0.00682*
	(0.00283)	(0.00292)	
tripling the VAT rates			
equivalised expenditures	0.25930	0.26396	-0.00466+
	(0.00248)	(0.00248)	
equivalised gross income	0.27910	0.28662	-0.00752**
	(0.00283)	(0.00294)	

Notes: + p<.10, * p<.05, ** p<.01. Standard errors in parentheses. RE = Gini coefficient pre-VAT − Gini coefficient post-VAT.
Source: Own calculation based on weighted HABE data 2009-2011.

As outlined, a revenue-neutral flat rate of 6.25 percent does not have a significant impact on the Gini coefficient of income or of expenditures. However, this does not imply that the introduction of a revenue-neutral flat rate has no impact on the VAT burden of individual households. Analysing the effects of a revenue-neutral flat rate on the VAT burden per equivalised decile, we find that the relative VAT burden of the lower deciles increases and the VAT burden of the higher deciles decreases compared to the status quo, see Tables 6 and 7. The relative VAT burden of the 7$^{\text{th}}$

and 8$^{\text{th}}$ deciles remains statistically unchanged.

Table 6
Average VAT burden, measured relative to expenditures, by decile of equivalised expenditures given a revenue-neutral flat rate of 6.25 percent

decile[a]	flat rate of 6.25%		average	difference 6.25% flat rate vs. ex. VAT		
	average VAT burden	standard error	VAT burden ex. VAT	absolute value	standard error	t-value[b]
1^{st}	.0405	.000396	.0361	.00431	.000182	23.7**
2^{nd}	.0396	.000296	.0368	.00281	.000159	17.6**
3^{rd}	.0399	.000275	.0377	.00224	.000131	17**
4^{th}	.0412	.000272	.0397	.00153	.000128	12**
5^{th}	.0415	.00025	.0405	.00101	.000122	8.29**
6^{th}	.0419	.000249	.0411	.00079	.000128	6.17**
7^{th}	.0418	.000264	.0417	.0001	.000117	.855
8^{th}	.0422	.000243	.0423	-.00007	.000113	-.65
9^{th}	.0432	.000241	.0437	-.00049	.000126	-3.86**
10^{th}	.0442	.000259	.0458	-.00161	.000123	-13**

Notes: + p<.10, * p<.05, ** p<.01. ex.=existing (see Table 2). [a]decile of equivalised expenditures. [b]t-value difference: t-values of testing whether the difference between the average VAT burden of a decile of equivalised expenditures of the existing VAT system differs from the corresponding burden with a simulated 6.25 percent flat rate.
Source: Own calculation based on weighted HABE data 2009-2011.

Table 7
Average VAT burden, measured relative to income, by decile of equivalised income given a revenue-neutral flat rate of 6.25 percent

decile[a]	flat rate of 6.25%		average	difference 6.25% flat rate vs. ex. VAT		
	average VAT burden	standard error	VAT burden ex. VAT	absolute value	standard error	t-value[b]
1^{st}	.0395	.000932	.0369	.00265	.000163	16.3**
2^{nd}	.0313	.00054	.0295	.0018	.000143	12.6**
3^{rd}	.0303	.000535	.0289	.00136	.000115	11.8**
4^{th}	.0289	.000508	.0281	.00075	.000108	6.97**
5^{th}	.0268	.000403	.0263	.0005	.000081	6.25**
6^{th}	.0261	.000392	.0259	.00018	.000089	2.08*
7^{th}	.0254	.000435	.0255	-.0001	.000094	-1.09
8^{th}	.0233	.000333	.0233	-.00003	.00007	-.477
9^{th}	.0233	.000361	.0237	-.00038	.000078	-4.89**
10^{th}	.0195	.000317	.0202	-.00065	.000066	-9.95**

Notes: + p<.10, * p<.05, ** p<.01. ex.=existing (see Table 3). [a]decile of equivalised income. [b]t-value difference: t-values of testing whether the difference between the average VAT burden of a decile of equivalised income of the existing VAT system differs from the corresponding burden with a simulated 6.25 percent flat rate.
Source: Own calculation based on weighted HABE data 2009-2011.

Based on our VAT simulations, we can conclude that a revenue-neutral flat rate could be introduced without affecting either income or expenditure distribution when measured based on the Gini coefficient. Nevertheless, a revenue-neutral flat rate increases the relative VAT burden of the lower equivalised deciles and decreases the relative VAT burden of the upper equivalised

deciles. This result indicates, in accordance with our findings from Section 5, that the existing VAT rate differentiation achieves some of its intended distributional impact, but overall has rather weak distributional implications.[67] Caution is advised when increasing the VAT rates since this might lead to statistically significant distributional effects: a regressive effect regarding income distribution and a progressive effect regarding expenditure distribution, given differentiated tax rates in the latter case. This underlines the importance of deciding whether the distributional VAT effect should be measured relative to income or relative to expenditures.

8. Isolating the part of the overall redistributive VAT effect attributable to differentiated VAT rates

As explained, the redistributive VAT effect can be attributed to the causes of different consumption propensities between households and different consumption patterns between households combined with differentiated tax rates and tax exemptions. Whereas different consumption propensities might cause a regressive impact on income distribution (at least with increased VAT rates), differentiated VAT rates are implemented to counteract this effect.

Therefore, in the following, we isolate the effect of different consumption patterns between households combined with differentiated tax rates and compare its magnitude with the overall redistributive VAT effect. The difference between the pre-tax income Gini coefficient and the post-tax income Gini coefficient (after deducting VAT) of a VAT system with differentiated rates is driven by different consumption propensities and different consumption patterns. The part of the overall redistributive VAT effect attributable to differentiated tax rates can be eliminated by replacing the differentiated VAT rates with a revenue-neutral flat rate and then measuring the difference between the pre-tax and the post-tax income Gini coefficient (after deducting VAT caused by this revenue-neutral flat rate). The effect of differentiated VAT rates, combined with different consumption patterns, on the income Gini coefficient can thus be isolated by measuring the difference between the post-tax income Gini coefficient stemming from a flat rate and that

[67] This result also reveals that the results might differ depending on the measurement method.

stemming from differentiated VAT rates.[68] We apply this approach to measure the impact of differentiated VAT rates of the current VAT system on the redistributive VAT effect. Further, as the redistributive effects based on the current VAT system are not statistically significant (see also Section 6) we also repeat this approach with differentiated VAT rates three times higher than the current differentiated VAT rates (see the VAT scenarios in Section 7).[69] We find that in both cases the regressive redistributive VAT effect is greater with a revenue-neutral flat rate than with differentiated rates, see Table 8. Therefore, differentiated VAT rates seem to counteract the impact of different consumption propensities on the redistributive VAT effect. However, the effect of differentiated VAT rates combined with different consumption patterns is slight: the effect of differentiated VAT rates on the income Gini coefficient is not statistically significant, even after tripling the current VAT rates.

Table 8
Isolating the part of different consumption patterns combined with differentiated VAT rates on the redistributive VAT effect

Gini coefficient equivalised income			difference Gini coefficients		
G_{inc}	G_{flat}	G_{diff}	$G_{inc} - G_{flat}$	$G_{inc} - G_{diff}$	$G_{flat} - G_{diff}$
existing VAT rates and revenue-neutral flat rate of 6.25 percent					
0.27910	0.28172	0.28127	-0.00262	-0.00218	0.00044
(0.00283)	(0.00287)	(0.00286)			
tripled VAT rates and revenue-neutral flat rate of 18.75 percent					
0.27910	0.28792	0.28662	-0.00883**	-0.00752**	0.00130
(0.00283)	(0.00294)	(0.00294)			

Notes: + p<.10, * p<.05, ** p<.01. Standard errors in parentheses. inc = equivalised gross income pre-VAT. flat = equivalised income after deducting VAT in a flat rate VAT system. diff = equivalised income after deducting VAT in a VAT system with differentiated VAT rates.
Source: Own calculation based on weighted HABE data 2009-2011.

The impact of different consumption propensities between households on the Gini coefficient can be measured by comparing the Gini coefficient of equivalised gross incomes with the concentration coefficient of equivalised consumption expenditures (ranking by equivalised gross income).[70] The different consumption propensities between households lead to reranking of households in the transition from the Gini coefficient of equivalised gross income to that of equivalised consumption

[68] For clarification, this isolated effect of differentiated VAT rates does not include the effect of tax exemptions on the redistributive VAT effect. The reason is that the simulated revenue-neutral flat rate VAT system maintains tax exemptions.
[69] The corresponding revenue-neutral flat rate amounts to 18.75 percent.
[70] Given identical consumption propensities, these two coefficients would be the same.

expenditures.[71] This reranking can be calculated as the difference between the Gini coefficient and the concentration coefficient (ranking by gross income) of equivalised consumption expenditures:

$$G_{inc} - G_{exp} = (G_{inc} - C_{exp}) - (G_{exp} - C_{exp}) \tag{2}$$

Table 9
The impact of different consumption propensities between households on the Gini coefficient

	G_{inc}	G_{exp}	C_{exp}	$G_{inc}-G_{exp}$	$G_{inc}-C_{exp}$	$G_{exp}-C_{exp}$
absolute	0.27910	0.26091	0.16878	0.01818	0.11031	0.09213
(in %*)	(100.00)	(93.49)	(60.47)	(6.51)	(39.53)	(33.01)

Notes: *in percent of G_{inc}. inc = equivalised gross income pre-VAT. exp = equivalised consumption expenditures including VAT. C_{exp} = concentration coefficient of equivalised consumption expenditures post-VAT with ranking by equivalised gross income.
Source: Own calculation based on weighted HABE data 2009-2011.

We find that equivalised consumption expenditures are distributed significantly more equally than equivalised gross income (see Table 9): the different consumption propensities decrease the Gini coefficient by about 6.5 percent. When household ranking is kept constant (ranking by equivalised gross income), the decrease is much greater: the consumption expenditure concentration coefficient corresponds to only about 60 percent of the equivalised gross income Gini coefficient. Therefore, different consumption propensities lead to extensive reranking when moving from income to expenditure distribution. This finding underlines the importance of the question of measuring the VAT burden relative to income or to expenditures.

We conclude that equivalised gross income is less equally distributed than equivalised consumption expenditures. This shows the relevance of the saving rate in measuring the redistributive VAT effect on income distribution. Further, we find that the effect of differentiated VAT rates combined with different consumption patterns on the overall redistributive VAT effect regarding income distribution is slight. Consequently, differentiated tax rates might be too weak an instrument to influence the redistributive VAT effect on income distribution and to counteract the part caused by different consumption propensities between households.

[71] See Section 3 for information regarding the Atkinson-Plotnick-Kakwani reranking index (R^{APK}).

9. Possibilities and limitations to make VAT progressive

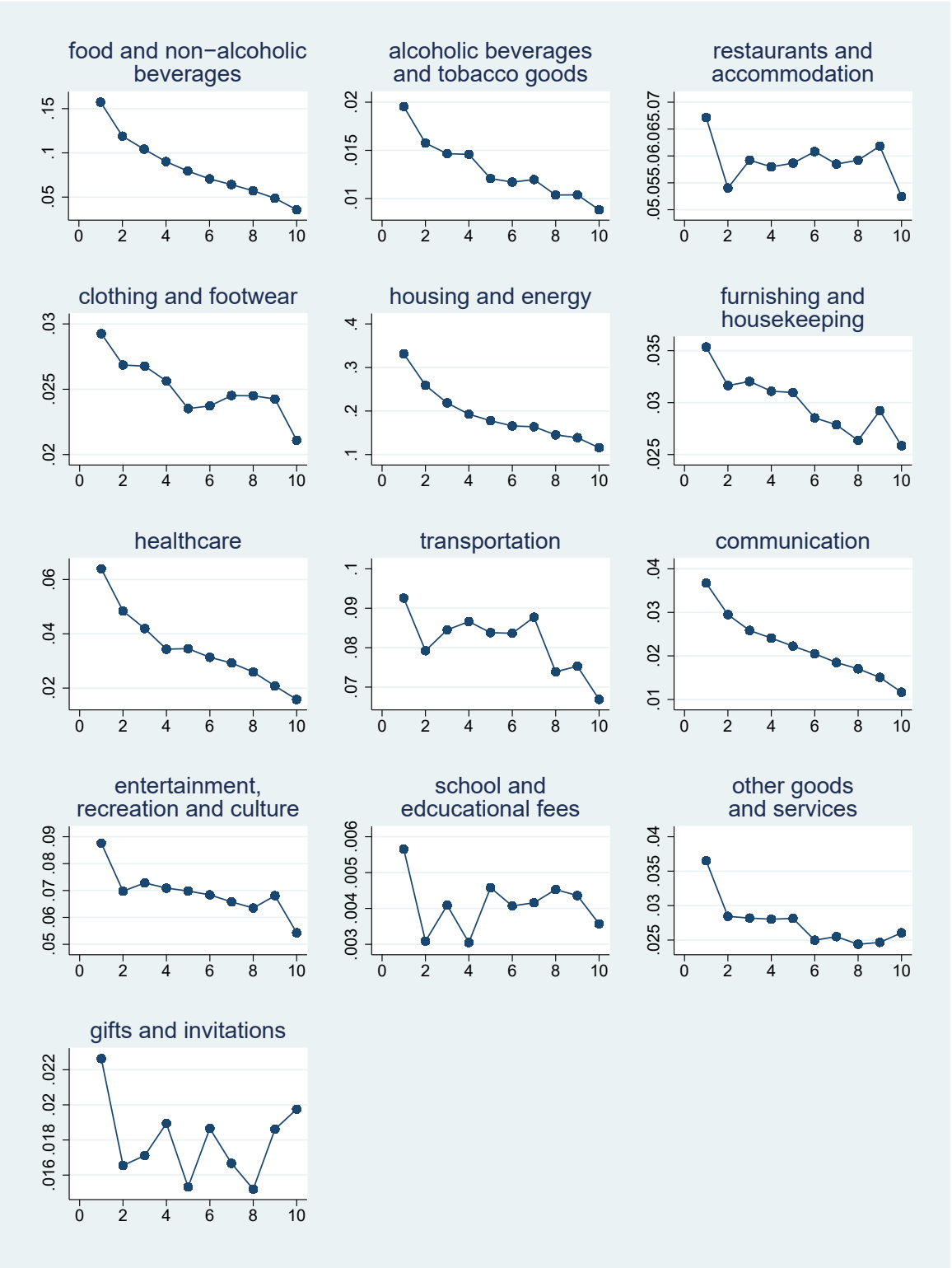
The current VAT system in Switzerland causes a regressive effect when the VAT burden is measured relative to income and per equivalised income decile (see Section 5). When measured based on the Gini coefficient, it causes no statistically significant redistribution (see Section 6). Therefore, to achieve a progressive VAT effect, meaning that households with higher incomes pay more VAT percentally to their income than households with lower incomes, the VAT rate structure needs to be adapted: Goods and services whose income shares increase with income should be taxed at a higher rate than those with income shares that decrease with income. Figure 5 illustrates the average income shares that are spent on different groups of goods and services by decile of equivalised income. Except for the last three charts illustrating the expenditure groups 'school and educational fees', 'other goods and services' and 'gifts and invitations', the income shares of all considered expenditure groups clearly decrease with income. This finding is confirmed by calculating the correlation coefficients between equivalised gross income and the income share spent per expenditure group (see Table 10). All calculated correlations are statistically significantly negative with the exception of the three expenditure groups mentioned above. The correlation between equivalised gross income and the income share spent on 'school and educational fees' as well as 'other goods and services' are also negative, but not significant and almost no correlation can be found between equivalised gross income and income share spent on 'gifts and invitations'.[72]

In the following, we analyse whether goods and services which show positive correlation between income share and equivalised gross income can be identified at a detailed consumption expenditure level : We find that only 63 of over 400 expenditure categories have positive correlations. These 63 categories together represent less than 15 percent of total consumption expenditures on average and less than 10 percent of gross income. Further, the correlation of only 16 of these 63 categories are significant[73] and the categories which are significantly positive together represent less than 5 percent of consumption expenditures on average and little more than 3 percent of gross income. Therefore, we can conclude that there are very few goods and services available for taxation at a

[72] Further, it is difficult to achieve a progressive effect by taxing goods and services from the expenditure group 'gifts and invitations' because it includes goods and services which are not only given away, but also consumed by the buyers themselves and therefore also included in other groups of goods and services.

[73] These 16 categories are significant at the 5 percent level.

Figure 5
Average income share spent per group of goods and services by decile of equivalised gross income



Notes: x-axis: decile of equivalised gross income. y-axis: income share.
Source: Own calculation and illustration based on weighted HABE data 2009-2011.

Table 10
Correlations between income shares of various consumption expenditure groups and equivalised gross income

	correlation coefficient	p-value
food and non-alcoholic beverages	-0.470	0.000**
alcoholic beverages and tobacco goods	-0.100	0.000**
restaurants and accommodation	-0.051	0.000**
clothing and footwear	-0.063	0.000**
housing and energy	-0.398	0.000**
furnishing and housekeeping	-0.046	0.000**
healthcare	-0.177	0.000**
transportation	-0.063	0.000**
communication	-0.341	0.000**
entertainment, recreation and culture	-0.103	0.000**
school and educational fees	-0.015	0.254
other goods and services	-0.036	0.153
gifts and invitations	0.000	0.989

Notes: + p<.10, * p<.05, ** p<.01.
Source: Own calculation based on weighted HABE data 2009-2011.

high VAT rate in order to achieve an equalising effect of taxation regarding income distribution. Moreover, to make the effect efficient and as great as possible, the focus should be on those goods and services out of the 16 significantly positive ones with the highest correlations and with the largest share of consumption expenditures. But taking a closer look at the three categories with the largest share of gross income - 'accommodation' with 0.83 percent[74], 'men's clothing' with 0.54 percent and 'passenger air transportation' with 0.34 percent - we find that two of them are currently not taxed at the normal rate (for different reasons): one is exempt from being taxed and one is taxed at the special rate.

To conclude, only a few goods and service categories can be identified with income shares which increase with equivalised gross income. Moreover, political and economic reasoning argues against (high) taxation of some of these categories. Therefore, a progressive VAT effect in the sense that households with a high income are more heavily taxed relative to income than households with lower income, is not feasible with the current consumption pattern.

[74]Includes the highly significant subcategory 'hotels, guesthouses and private rooms'.

10. Concluding remarks

Our first results indicate that differentiated VAT rates have at least some intended distributional impact on the VAT burden since higher deciles of equivalised consumption expenditures have, on average, a higher share of consumption expenditures taxed at the normal VAT rate than lower deciles. Consequently, the average VAT burden, measured relative to expenditures, increases with increasing deciles of equivalised expenditures. On the other hand, when measured relative to gross income, the average VAT burden decreases with increasing deciles of equivalised gross income and Swiss VAT appears to be regressive regarding income distribution. We identify the saving rate, which clearly increases with income, as a reason for this potentially changing progression effect. However, the findings that the VAT system is progressive with respect to expenditures and regressive with respect to income cannot be confirmed based on the redistributive VAT effects on the Gini coefficient: the Gini coefficients for equivalised gross income and equivalised consumption expenditure are both greater pre- than post-VAT but in both cases, the difference is not statistically significant. According to our simulation, neither does a revenue-neutral flat rate of 6.25 percent cause any statistically significant redistributive effect on the Gini coefficient. Nevertheless, the introduction of a revenue-neutral flat rate would change the relative VAT burden of most equivalised deciles compared with the status quo: the lower deciles would be taxed more and the highest two deciles less. However, an increase in VAT taxation (with a flat-rate of 15 percent or by tripling the VAT rates) might cause a statistically significant regressive effect regarding the income Gini coefficient and, in the case of tripling the VAT rates, also a statistically significant progressive effect regarding the expenditure Gini coefficient. Further, we find that different consumption propensities between households lead to extensive reranking when moving from income to expenditure distribution. Isolating the impact of different consumption patterns between households, combined with the differentiated tax rates, from the overall redistributive VAT effect on the income Gini coefficient, we find that this impact is slight. Therefore, differentiated tax rates seem inadequate as a counterpart to the impact of different consumption propensities between households on the distributional effect of VAT on the income distribution. In addition, to render VAT potentially progressive with respect to income distribution, goods and services with a pos-

itive correlation between income share and equivalised gross income are needed. However, VAT taxation which is higher percentally to income for households with higher equivalised gross income is not feasible with the current consumption pattern, because only a few goods and services can be identified which have income shares that increase with equivalised gross income. Moreover, some of these goods and services are currently not taxed with at normal VAT rate for political or economic reasons.

In the political discussion on VAT and especially on differentiated VAT rates, redistributive arguments are important (see also Section 1) - albeit arguments not related to distribution might also be taken into account.[75] Based on our analyses, we conclude that the existing differentiation of VAT rates cannot make VAT be progressive regarding income distribution. Also, a different VAT rate structure might not change this situation because VAT which is progressive regarding income distribution might not be feasible given the current consumption patterns in Switzerland. Consequently, existing, but also potentially new differentiated tax rates, must be reviewed critically, at least from a distributional view. Another reason for reviewing (new) differentiated tax rates critically is that the impact of differentiated tax rates on the VAT burden, measured relative to income, is small compared to the overall redistributive VAT effect. To conclude, our findings call for a prioritisation of efficiency over distributional considerations in structuring the VAT system. Moreover, a revenue-neutral uniform VAT rate could be introduced without impairing the redistributive VAT effect on the Gini coefficient. A flat-rate would be preferable to the existing system (with differentiated tax rates) because collection and payment costs as well as political-economic arguments unequivocally favour a flat rate (see Section 1): A flat-rate would allow an increase in VAT revenue, while keeping all VAT related expenditures constant, or a reduction in VAT related expenditures, while keeping VAT revenue constant.[76] Further, a clear decision should be made in the political discourse as to whether fiscal performance capability should be measured by periodical consumption or by income. Basing fiscal performance capability on periodical consumption, the VAT burden should be measured relative to expenditures. In this case, a revenue increasing

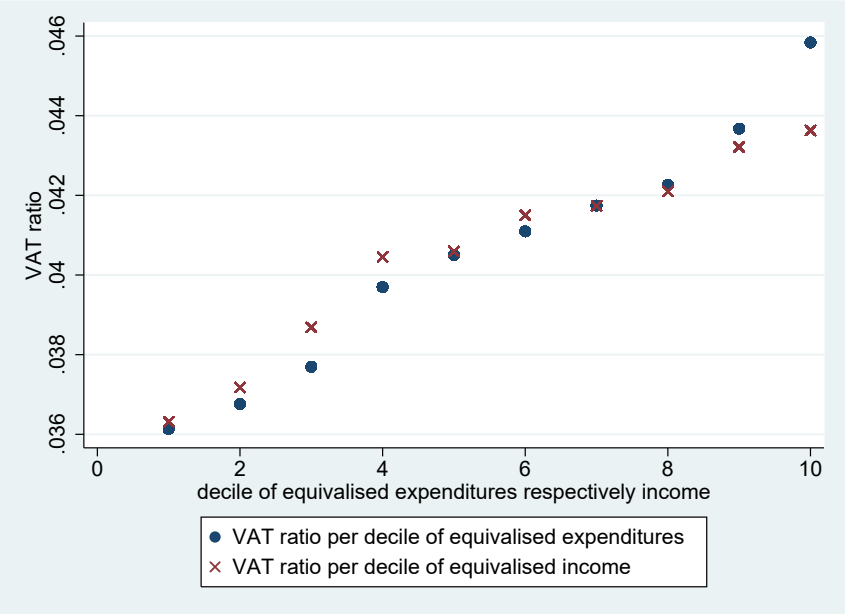
[75] For example, an argument for keeping differentiated tax rates which is not related to distribution is given by Kaplanoglou and Newbery (2008): they argue that differentiated tax rates might be implemented to correct adverse consumer behaviour.

[76] With the introduction of a flat rate, the Swiss VAT system would at least fulfil two out of five criteria of the definition of an ideal VAT (Bundesrat, 2005, p. 44 f.)

flat rate could be introduced without causing redistribution, and tripling the VAT rates of the current VAT system would cause a progressive effect, measured based on the Gini coefficient of the equivalised expenditures. Finally, all arguments for and against measuring fiscal performance capability by periodical consumption or by income and for and against differentiated VAT rates must be balanced at a political level.

A. Appendix

Figure 6
VAT burden relative to expenditures by decile of equivalised expenditures vs. decile of equivalised income



Notes: VAT ratio = VAT burden relative to expenditures.
Source: Own calculation and illustration based on weighted HABE data 2009-2011.

Table 11
Average saving rate per decile of equivalised income

decile of eq. income	average saving rate	standard error	95% confidence interval		t-value difference[a]
			lower bound	upper bound	
1^{st}	-.2892	.02308	-.3344	-.2439	.
2^{nd}	-.0246	.0118	-.0478	-.0015	10.2**
3^{rd}	.0292	.01715	-.0044	.0628	2.59**
4^{th}	.0534	.01101	.0319	.075	1.19
5^{th}	.076	.00952	.0573	.0947	1.55
6^{th}	.1134	.00868	.0964	.1304	2.9**
7^{th}	.1351	.01582	.1041	.1661	1.2
8^{th}	.1659	.01009	.1461	.1857	1.64
9^{th}	.1734	.01038	.153	.1937	.515
10^{th}	.2247	.01328	.1986	.2507	3.04**

Notes: + p<.10, * p<.05, ** p<.01. eq.=equivalent. [a] t-value difference: shows the t-values of testing whether the average saving rate per decile of equivalised income differs from the adjacent lower decile.
Source: Own calculation based on weighted HABE data 2009-2011.

B. Disclosures

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