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The Measurement of Effective Tax Rates: Common Themes in Business Management and Economics

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Non-Technical Summary

To cope with the international variety of tax systems, business managers, economists and other groups interested in taxation demand condensed but sophisticated information on effective tax burdens associated with different tax systems. Various quantitative approaches to calculate effective levels of capital income taxation have been developed in economics and in business management. The scope of this paper is to highlight the common themes of these approaches and to elaborate their ranges of application.

We present forward-looking approaches for measuring statutory and effective tax burdens on capital income and define some properties of the measures which appear to be useful for the investigation and communication of effective tax burdens. We compare the measures of effective marginal and effective average tax burdens, and we compare different types of approaches based on model firms or on neoclassical investment theory.

We show the connections between the traditional approach for measuring effective marginal tax burdens by *King/ Fullerton* and a more recent approach which also permits the calculation of effective average tax burdens by *Devereux/ Griffith*. A strong bridge between both approaches can be established by slightly redefining *Devereux/ Griffith's* measure.

The purpose of these comparisons is to evaluate the different measures and approaches with respect to their usefulness for investigating the effects of taxation on decision-making, competition, and distributional aspects. In fact, the variety of instruments permits a broad coverage of economic issues. However, not all approaches are equally suited for all problems. It is necessary to reveal the scope of the measurement and to carefully choose the right measure and approach.

The Measurement of Effective Tax Rates: Common Themes in Business Management and Economics

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Abstract

Economic agents who face the diversity of tax systems demand condensed but sophisticated information on effective tax burdens. We analyse common features and differences between important forward-looking concepts of measuring effective tax rates in business management and economics and develop some useful properties for analysing and communicating them. We explore how the instruments can be employed to provide information on the impact of taxation on decision-making, competition, and distribution. The large variety of instruments proves very useful. However, it turns out to be necessary to reveal the measurement's scope and to carefully choose the adequate approach and measure.

JEL-Classification: H21, H25, H32, M21

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Structure of the Paper

1 Introduction

While markets become more and more global, tax systems stay local, and there is an increasing diversity of tax systems that are relevant for economic agents who decide on investments or compete in international markets. To cope with this variety, business managers, economists and other groups interested in taxation, especially those who make and review tax systems, demand condensed but sophisticated information on effective tax burdens associated with different tax systems.

There are various quantitative approaches to calculate effective levels of taxation that have been developed in economics and in business management. The scope of this paper is to highlight the common themes of these approaches and to elaborate their ranges of application.

To sharpen the focus of our analysis, we restrict our investigation to the taxation of business capital.[1] Furthermore, as we are especially interested in the effects of taxation on firm behaviour and future performance, we will focus on forward-looking indicators of effective tax burdens. By comparing these approaches, we will refer to some core models, which do not take into account a number of economic issues, e.g. effects of inflation or aspects of uncertainty.

The structure of the paper is as follows: Starting off from an analysis of the addressees and the objectives of tax burden comparisons, we briefly review the most important economic aspects connected with taxation. These are decision-making, competition, and distributional issues (section 2).

In section 3, we present approaches for measuring statutory and effective tax burdens. We concentrate on forward-looking approaches and define some properties of the measures which appear to be useful for the investigation and communication of effective tax burdens. Depending on the scope of the measurement, we further define alternative dimensions of investigation, which might help to shed light on different economic issues.

Section 4 goes into the details of the most important forward-looking approaches. We compare the measures of effective marginal and effective average tax burdens, and we compare different types of approaches based on model firms or on neoclassical investment theory. We show the connections between

[1] Thus we do not consider business taxation as a whole, which, for example, would also include the taxation of entrepreneurial labour. Furthermore, we do not consider the impact of taxation on saving decisions.

the traditional approach for measuring effective marginal tax burdens by *King/ Fullerton* and a more recent approach which also permits the calculation of effective average tax burdens by *Devereux/ Griffith*. A strong bridge between both approaches can be established by slightly redefining *Devereux/ Griffith's* measure. The purpose of these comparisons is to evaluate the different measures and approaches with respect to their usefulness for investigating the economic issues mentioned in section 2. In fact, the variety of instruments permits a broad coverage of economic issues. However, it is necessary to reveal the scope of the measurement and to carefully choose the right measure and approach.

Section 5 finally summarises the most important results.

2 Objectives of Measuring Effective Tax Burdens with Respect to Economic Issues

2.1 Addressees of Tax Burden Comparisons

For measuring effective tax burdens, it is necessary to know the scope and the purpose of the measurement.[2] These are crucially related to who the addressees of the tax burden comparison are. Three categories of addressees can be deemed particularly relevant here:

First, business managers might be interested in effective tax burdens. Taxation has a negative impact on cash flows and profits, i.e. taxation is relevant for the determination of post-tax results. More importantly, taxation might change the ranking of different alternatives, i.e. it is relevant for decision-making. Business managers might increase post-tax performance by considering different levels of taxation on different decision alternatives.[3] Thus, for business managers, post-tax results are especially important as they give advice on which alternative to choose.

Second, economists are interested in effective tax burdens. Their objective is to show potential economic inefficiencies that arise when taxation comes at an additional welfare cost. This occurs when decisions are distorted by taxation. Then, pre-tax income in case taxes were not considered might be greater than the sum of post-tax income and the amount of taxes collected if taxes were considered in decision-making.

[2] See *Schneider* (1992), p. 186.

[3] See *Georgi* (1994), p. 4.

In order to be able to analyse these issues, economists must predict the decision behaviour of economic agents, in this case business managers. Therefore, their approaches have to consider models used for managerial decision-making. However, compared with business managers, economists are more interested in pre-tax income after taxes have been considered than in post-tax income. This is because differences in pre-tax income due to taxation in general constitute welfare losses.

The economic analysis of taxation is not an end in itself. Thus the third important group that is interested in effective tax burdens and that is supplied with information by economists and by business managers consists of politicians, law professionals, i.e., those who make and review political decisions on tax systems, and last but not least the general public that has to evaluate tax systems in a democratic society.

If politicians acted to maximise social welfare, they would consider economic distortions due to tax legislation. Analyses of effective tax burdens in those cases might be useful to detect these distortions and to define and evaluate alternative legislation which might reduce them and thus might improve welfare.

2.2 Economic Issues Considered

From an economic perspective, the focus of the evaluation of tax regimes lies on three issues: decision-making, competition, and distributional issues.

2.2.1 Decision-making

At the core of decision-making there is the perspective of a single person, i.e., the person of the decider is fixed and the tax burden on different alternatives is considered. Taxation has an impact on decision-making if the ranking of the alternatives before and after taking taxes into account is different. The most important decisions with respect to business capital are investment decisions, which include location decisions, and financing decisions.

Investment decisions concern the decision of how to transform financial funds into (real) capital. Taxation does not influence investment decisions if it does not affect the ranking of different projects. Depending on the type of investment choice, this might have different implications.

From the point of view of a business manager, many investment decisions exhibit a discrete, mutually exclusive character and earn more than the minimum expected return. When facing a choice of alternatives, firms will realise only the investment with the greatest post-tax value. If performance is measured by net present values, investment decisions are not affected by taxation if[4]

$$NPV^A > NPV^B \Rightarrow NPV_t^A > NPV_t^B \quad \text{and} \tag{1}$$

$$NPV_t^A > NPV_t^B \Rightarrow NPV^A > NPV^B \tag{2}$$

are satisfied for all investment alternatives *A*, *B*, where NPV and NPV_t denote the pre-tax and post-tax net present values, respectively.

In other cases, decisions might have a non-discrete character. If a manager has relatively free access to capital markets and the capital stock can be varied arbitrarily, under the assumption of a decreasing marginal product of capital it is optimal to invest up to the point where additional investments earn exactly the minimum rate of return accepted by the shareholders. Formally, neutrality with respect to decision-making implies that

$$NPV = 0 \Rightarrow NPV_t = 0 \qquad \text{for all investments.} \tag{3}$$

Knowing about effective tax burdens of alternative investments is important for business managers to maximise shareholder value. Under a neutral tax system, there is no need to take tax issues into account. Realising the project with the highest pre-tax income would also maximise shareholder value.

From the point of view of an economist, the main goal of tax neutrality with respect to investment decisions is to ensure production efficiency. It should not be possible to reallocate capital between investments to raise pre-tax income of the economy or the world. Production efficiency is satisfied if the pre-tax marginal rate of return is equal across all investments and, with respect to discrete investment choices, those inframarginal investments which earn the highest pre-tax yield are undertaken.

One especially relevant type of investment decision is the location decision. Effective tax burdens often differ substantially between jurisdictions as tax codes

[4] The first of the two conditions would be sufficient to ensure an efficient allocation. By adding the second condition, it is secured that equal pre-tax net present values imply equal post-tax net present values. If there are no externalities, the combination of these two conditions is only important for an economic agent who is interested in maximising post-tax results, but not for an economist, as both alternatives are equally favourable before taxes.

are set nationally. Often, a firm going abroad expects to earn an economic rent,[5] and the location decision can be assumed to be of the discrete type mentioned above.[6]

Such an economic rent can be split into two components that might also appear in combination: (1) A firm-specific economic rent. An example might be the case of an international patent. (2) An economic rent that is tied to a specific location. An extreme case would be mining or petroleum exploration. Also, such an economic rent might be generated by a highly developed infrastructure which is offered by a particular location.[7]

Assume that a corporation has the opportunity of locating a manufacturing plant in the EU-countries A or B or alternatively in the non-EU-country C. The economic rent associated with these investments would be 12 (A), 10 (B), and 5 (C). The firm-specific rent is 5, the EU-wide economic rent is 5, and the economic rent of manufacturing in country A is 2. Theoretically, country A could levy a tax on the economic rent of very close to 2, the EU or country A and B jointly could levy a tax of very close to 5, and C could not levy any tax unless A or B overtaxed their part of the economic rent. Then, an economic inefficiency would result if the corporation settled in any country but country A and the location-specific economic rent could not be offered to any other company, i.e., it is lost for the whole world. Thus the location-specific part of the economic rent can theoretically be almost fully captured by taxation without any welfare loss. E.g., a country that offers an infrastructure that is more favourable from the point of view of a company might be able to demand higher taxes. In contrast, under unlimited tax competition the mobile part of the rent cannot be taxed.

Governments might employ a tax system that exclusively taxes economic rents, like the cash flow tax or a tax based on an allowance for corporate equity (ACE). Their dilemma is, however, that for practical reasons or legal requirements they often cannot differentiate between mobile and location-specific rents. A business manager deciding on where to locate a business would choose the location that offers him the highest post-tax economic rent, regardless of its

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[5] See *Richter/ Seitz/ Wiegard* (1996), p. 19; *Bond* (2000), p. 171; *Devereux* (2000), p. 113. For a brief review of the particular economic conditions for an environment that enhances the activities of multinational enterprises, see *Markusen* (1995), who especially discusses *Dunning's* OLI (ownership-location-internalisation)-framework.

[6] See *Devereux/ Griffith* (1998), p. 337; *Devereux/ Griffith* (1999), pp. 7-11.

[7] See *Richter/ Seitz/ Wiegard* (1996).

composition. Tax systems that place a heavy burden on economic rents might thus deter investment in that country.

Location decisions can also exhibit the non-discrete character, when e.g. a firm's or the economy's capital stock is adjusted to the optimum in each country.

However, decisions that might appear to be discrete from the point of view of business management, e.g. due to indivisibility, might be non-discrete from the point of view of the whole economy, as in the aggregate there might be effects on the marginal productivity of a whole economy even if a single investor would not realise this for his decision. Also, as different mechanisms might drive the marginal product of a single firm compared with a whole economy, the implications of taxation might be different from the perspective of a single firm compared with the perspective of the whole economy.

Financing decisions concern the choice of obtaining funds for an investment. Typically, three sources of finance are considered: retained earnings, new equity, and debt. Financing decisions can be internal or external, depending on whether the decider is the one who also supplies the funds (e.g. financing inside a group of companies, or financing of a closely held partnership by the partner) or not. Taking a broader view of this decision, also the choice of the organisational form of an investment is a financing decision as it determines the legal character of the equity supplied.

From a business management point of view, financing decisions are in some respect not very different from investment decisions, only the sign of the first payment is positive, whereas for investment decisions it is negative.[8] Choosing a tax-favoured way of financing the company may boost shareholder value the same way as choosing a tax-favoured investment.

From an economic point of view, there are three important positions on whether distortions to the financing decision are harmful or not. Some argue that distortions might improve social welfare as undistorted financing decisions are driven by external effects and thus need a correction[9], which might be implemented by the tax system. Others argue that undistorted financing decisions perform better in maximising social welfare than distorted ones. A third important opinion is

[8] See *Hållsten* (1966), pp. 17-18; *Schneider* (1992), p. 21.

[9] For example *Schneider* (2002), p. 175, argues in favour of adjusting tax burdens to take into account different risk positions associated with different sources of finance.

that a distortion of financing decisions does not matter as long as different sources of finance are close substitutes. It has been noted that distortions of real investment decisions might be reduced in case there is one source of finance which is neutrally taxed; this might act as a "buffer"[10].

To conclude, a complete picture of distortions of investment decisions cannot be drawn without considering alternative financing decisions.

2.2.2 Competition

In contrast to decision-making, an analysis of distortions to competition cannot observe the economy from the point of view of a single agent. It has to rely on the comparison of the situation of at least two competing agents.

Competition is distorted if any agent who is more or similarly competitive than one of his or her rivals before taxes are taken into account will be less competitive after taxes. Competitiveness can be tied to the instruments of competition between businesses, which may be prices or product quality.[11] As product quality is difficult to measure, we assume comparable products and only price competition. As long as an economic rent is earned, the business might reduce prices until the economic rent earned is zero. The tax system discriminates against a competitor who ceteris paribus requires a greater price for the same product than his rival.

Issues of competitiveness are closely connected to decision issues. It is important to find out the most tax-efficient way of structuring and financing the investment in a first stage, i.e. to undertake some tax optimisation, to find the lowest acceptable price for each competitor. Also, competition issues might prevent a firm from taking on business. Thus it might predetermine the decision to enter a specific market.

To optimise their strategies for serving particular markets, business managers should take into account the effects of taxation on their own and their rivals' competitiveness. Economists might point out welfare losses if these effects deterred a more efficient company from serving a market.

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[10] *Sinn* (1987), p. 181.

[11] See *Maiterth* (2001) p. 102.

2.2.3 Distributional Aspects

The distributional aspects of taxation are in the centre of a number of economic studies.[12] It is, however, very difficult to find out the impact of taxation on the relative well-being of individuals. Also, it is difficult to formulate a normative statement on how or whether at all taxes should affect distribution. Therefore, we will restrict our study to only a few remarks on the usefulness of the tax burden measures presented for distributional analyses.

3 Approaches for Measuring Effective Tax Burdens

3.1 Backward- Versus Forward-Looking Measures

For measuring tax burdens, a number of different instruments exist.[13]

First, there are comparisons of statutory tax rates. These measures only consider the interrelations of headline tax rates. Differences in the definition of tax bases cannot be considered. These comparisons can be very informative, as the headline tax rate is an important parameter of a tax system,[14] but they cannot be classified as "effective" tax rates. An effective tax rate would be based not on taxable profit as defined by law but on an economic measure and thus would also consider the impact of the tax base.

Turning towards effective tax rates, there are, second, backward-looking measures. These can be calculated from firm data or macroeconomic data. Tax payments from national or firm accounts are based on some measure of profit or operating surplus reported by companies. Besides a number of detailed problems regarding the consistency of the data used in the numerator and the denominator of the measure and regarding the international comparability of the employed data,[15] these measures are conceptually not suited to evaluate the effects of taxation on business decision-making. Decisions are based on the future tax burdens connected with a particular decision. Backward-looking effective

[12] For a recent extensive review of studies on tax incidence, see *Fullerton/ Metcalf* (2002).

[13] See *Jacobs/ Spengel* (2000); *OECD* (2000); *Spengel/ Lammersen* (2001), pp. 223-225.

[14] The headline tax rate is so important because it determines the value of profit-shifting opportunities, because it shows the tax burden on an additional unit of profit and also because it might be a strong signal for potential investors who cannot judge the impact of other components of the tax system without deeper investigations.

[15] See *OECD* (2001), pp. 7, 11.

tax burdens can usually not be connected to a particular decision, and it is not possible to identify the so-called "tax-drivers" by relying on backward-looking measures. They are not connected to future tax payments either. For similar reasons, they cannot give information on the impact of taxation on future competitiveness of firms.

If applied carefully, backward-looking measures, however, can be useful for ex-post analyses on who paid the taxes in an economy, which might be an indicator for distributional aspects of a tax system. Also, backward-looking measures are sometimes used in business management to evaluate the ex-post performance of company tax departments.[16]

Thus we have to turn towards the third category of tax burden measures: forward-looking measures. These take into consideration expected tax payments associated with particular decisions. Thus they are potentially suited for estimating the effects of taxation on business decision-making.

These measures are used in economics as well as in business management; in the past, however, different approaches have been preferred in both disciplines. Business management often relied on more or less detailed model-firm approaches. Economic studies, by contrast, employed models based on neoclassical investment theory. Both types of approaches are based on measures of economic performance. We briefly review these measures before turning towards a closer look at the approaches.

3.2 Measures of Economic Performance

To measure expected economic performance, a number of economic values can be constructed. In general, these are cash flow-based measures that serve as a starting point for measuring the impact of taxation on these economic goal variables. The most important concepts for measuring expected economic performance are rates of return and net present values.

We define rates of return in a broad sense to cover all measures that tie the income generated by a project to the amount invested. These might be internal rates of return, growth rates, or one-period rates of return. Rates of return are a reliable and intuitively comprehensible measure of performance. They are de-

[16] See *Herzig/ Dempfle* (2002), pp. 1, 8.

fined relative to the capital invested.[17] In contrast to the second important performance measures, net present values, rates of return are not defined relative to an alternative that also generates positive returns.

Net present values denote the minimum amount an investor would expect in turn for giving up a particular investment opportunity. They are driven by the cash flows generated by the investment project considered, but also by the opportunity cost of the investor. If we assume the alternative use of funds to be a bank deposit at the single market interest rate, a cash flow tax does not change the opportunity cost of an investment as it leaves interest income effectively untaxed. Thus it cuts net present values proportionally. A neutral comprehensive income tax following the outlines laid by *Johansson* and *Samuelson*, which taxes interest at the statutory rate and where allowances are based on the decline of the earnings capacity value of the investment, however, leaves valuations and thus net present values unchanged.[18] The effects of taxation on the income generated from the investment and those on the opportunity cost exactly cancel out. Although there is a positive present value of tax payments, the effective tax burden displayed by the difference of pre-tax and post-tax net present values is zero.

There are more performance measures, e.g. final values, which can be used for tax burden comparisons, but which are not directly addressed here as they are not very common and as their properties are more or less comparable to those of the two types of measures mentioned above.

Rates of return and net present values are measures of profitability. However, both decision-making and competitiveness might also depend on liquidity aspects. These aspects could, for example, enter the considerations as a side condition, i.e. the strategy could be to maximise profitability and to take care of a minimum liquidity in each of the periods.

3.3 Useful Properties of Effective Tax Burden Measures

In order to measure effective tax burdens related to a future project, one needs to analyse the tax-induced change in the goal variable of the decider. To trans-

[17] Here we focus on rates of return based on the return to assets. Rates of return might also be based on equity invested. That approach, however, might mask tax effects. E.g., under a cash flow tax the private rate of return is not affected: The equity invested and the proceedings are cut by the same rate.
[18] See *Johansson* (1961), pp. 211-216, and (1969); *Samuelson* (1964).

late this change into an effective tax rate, usually the difference between the post-tax and the pre-tax value of the goal variable is divided by the pre-tax value. By proceeding this way, consistency and interpretability of effective tax rates can be promoted since the measure will potentially exhibit some very useful properties.

(1) The most important property of decision-based effective tax rates is of an ordinal nature: Higher (lower) effective tax rates should indicate less (more) favoured alternatives, equal effective tax rates should indicate indifference. If this were not the case, an effective tax rate would not be able to predict decision behaviour.

(2) Second, it is useful to rely on a zero point which indicates investment neutrality with respect to the standard alternative. For marginal investments, this standard alternative is considered in the calculation of the discount rate and is usually a standard financial asset which yields the market interest rate. A particular value of the effective tax rate should indicate neutrality between the investment and this alternative, thus for a whole tax system to be neutral, the effective tax rate on each equally favourable alternative should equal this benchmark effective tax rate. The importance of this standard alternative is based on the fact that it is compared to every investment in the whole economy. Deviations in the effective tax rate from this benchmark thus permit to state generally whether an alternative is tax-preferred or tax-disadvantaged.

(3) Third, the standard measure could be tied to an intuitively comprehensible benchmark value. A good choice would be the well-known concept of the statutory tax rate or the fraction of tax that would be taken from the income generated by a one-period investment.[19] An effective tax rate below this value would indicate that an alternative is favoured by the tax system, possibly due to an especially generous definition of the tax base or a special, favourable interplay of statutory tax rates of different tax types (e.g. the corporate tax system, i.e. the integration between corporate and personal taxes).[20]

[19] This might be relevant e.g. for a tax based on an allowance for corporate equity. Under an interest rate of 5 % and a statutory tax rate of 40 %, an investment of 1,000 which generates a return of 100 would be expected to pay 20 (20 %) in taxes, whereas if the return was only 50 the tax burden would be zero (0 %), both indicating the proper implementation of this neutral tax system.

[20] This has been noted by *Schneider*, see, for example, *Schneider* (2002), pp. 112-113.

This promotes the communication and the widespread use of a concept of effective tax rates.[21]

(4) Fourth, to fully exploit the advantages laid out in properties (1) to (3), an effective tax rate that deviates from the benchmark value could also be connected in some way to the concept that delivered this value. For example, if it was based on the statutory tax rate, an effective tax rate that deviated from the statutory tax rate by, say, 5 percentage points due to a generous definition of the tax base would be equivalent to a 5 percentage point reduction in the statutory tax rate under neutral depreciation rules.

Obviously, as decision-making and competition always consider the ranking of alternative projects, and as property (1) is sufficient to show the impact of taxation on these projects, only property (1) is required to obtain valid results. Properties (2) to (4), however, appear to be very useful to promote the use of a concept of effective tax rates.

First, they make them comprehensible also to those who are non-specialists in tax burden comparisons, especially to the third group mentioned in section 2.1, i.e. those who make and review tax systems.

Second, the most important insights tax burden comparisons can generate are those that help identifying and analysing the tax drivers, i.e. that promote logical conclusions about the impact of different components of a tax system. The properties shown above permit more general conclusions on whether a tax system treats alternatives and firms systematically equal, and they help evaluating the sources and the sizes of an unequal treatment.

3.4 Dimensions of Investigation

3.4.1 Type and Level of Profitability of the Unit Regarded

A first dimension of investigation of effective tax burdens considers the type and the level of profitability of the unit regarded. The investment considered might be (1) a whole business, or (2) an additional business or investment unit for an existing business. From the point of view of business administration, in the standard case a whole business unit is assumed to be profitable and earns an

[21] E.g. business managers rely on ex post measures of performance of their tax departments that are based on company tax quotas, where a tax quota below some (weighted) statutory tax rate might indicate a good performance.

economic rent. This does not need to be the case for an additional unit. Thus an additional unit might be (2a) an additional project that earns an economic rent or (2b) the last unit of investment that is worthwhile to be undertaken and thus marginal in an economic sense.

As for the effective tax burdens on these different types of investment sometimes the same terms are used in literature, there is potential for confusion.[22] To avoid confusion, we will use the term 'marginal' for investments that are marginal in the economic sense and the term 'effective marginal tax rate' (*EMTR*) for the effective tax rate on post-tax marginal investments, as opposed to 'average' and 'effective average tax rate' (*EATR*) for inframarginal investments.

3.4.2 Shareholder Taxation

A second dimension of investigation asks whether shareholder taxation should be included. Usually, shareholder taxation is personal taxation, as the ultimate shareholder of a company always is an individual. However, a group of companies might be organised in a multi-level structure, thus for a two-tier corporation, three levels of taxation exist: taxation at the level of the subsidiary, taxation at the level of the corporate group, and taxation at the so-called overall level consisting of the group of companies and its ultimate shareholders.

With respect to the question which levels and which type of individual shareholder should be included, a number of suggestions exist. To summarise this discussion, there are good reasons to assume that shareholder taxation is less important for business decisions the bigger the corporation in view is, the more integrated international capital markets are, and the less shareholder taxation discriminates between different alternatives. To capture most relevant cases, however, usually a number of simulations assuming different ultimate shareholders and different structures of the corporate group are undertaken. By analysing the sensitivity of the results with respect to these different structures,

[22] The term 'effective marginal tax rate' is used for the tax burden on investments that are marginal in the sense of 'additional' (category (2) of the above) as well as for those that are marginal in an economic sense (category (2b)). The 'effective average tax rate' is frequently used as the opposite of the 'effective marginal tax rate' and thus also serves for at least two different purposes: First, it denotes the effective tax burden on a whole business unit (category (1) of the above) or, alternatively, on the whole income of a person who decides and who bears the tax consequences. Second, it describes the effective tax burden on projects that are inframarginal in an economic sense, i.e. that earn an economic rent.

analysts can gain a number of valuable insights into the tax drivers at different levels of taxation.

3.4.3 Top-down Versus Bottom-up Approach

A third dimension of investigation considers the economic starting point of the measurement of tax burdens. To isolate the effects of taxation, non-tax effects on the favourability of investments have to be omitted. Then we can distinguish between top-down or bottom-up analyses.

Top-down means that the alternatives under investigation are equal with respect to their pre-tax rate of profitability p and might differ with respect to their post-tax rate of return r. For profitable investments, this is equivalent to the assumption that they earn the same economic rent before taxes are considered. This is not necessarily true for the marginal case. By definition of the marginal investment, there is one degree of freedom less in changing parameters, as the marginal investment is a special case of all investments. Once the pre-tax rate of return of the marginal investment $\tilde{p}$ is set, another parameter is affected to secure the post-tax marginality of the investment. This parameter usually is the real market interest rate, which we denote by i.[23]

We obtain a fixed-p-case for the inframarginal case, where the post-tax rate of return of the investment r depends on the pre-tax rate of return of the investment p and the tax system, and where the real market interest rate i is exogenous. And we obtain a fixed-$\tilde{p}$-case[24] for marginal investments, where r is equal to the minimum post-tax rate of return demanded by the shareholder s so that the net present value of the investment $R = 0$ and i is endogenous.

Bottom-up means that a given post-tax value is assumed and the corresponding pre-tax value is calculated. Theoretically, this bottom-up process can start off from any of the levels mentioned in section 3.4.2. For inframarginal investments, an expected post-tax economic rent can be defined and the corresponding pre-tax economic rent can be calculated. For marginal investments, the real market interest rate i (fixed-i-case[25]) or the post-tax rates of return r (fixed-r-

[23] The standard notation for this parameter is r, however, we choose the notation i to avoid confusion with the more general post-tax rate of return to the shareholder r.

[24] The "fixed-p-case" in terms of *King/ Fullerton* (1984). We have changed the expression to match the notation of this paper.

[25] The "fixed-r-case" in terms of *King/ Fullerton* (1984).

case) for the shareholder are equalised, and the pre-tax rate of return required to generate this minimum accepted post-tax rate is calculated.

The choice between top-down or bottom-up calculations is not easy. Business managers might prefer the fixed-*p*-case when deciding about inframarginal, discrete investment choices that are equal from their point of view before taxes are taken into account. They might be tempted to do so also for the marginal case, but this would imply a variation in the market interest rate, which is not convincing from the point of view of a business manager, who acts as a price taker with respect to the market interest rate.

Economists typically rely on arbitrage assumptions to argue in favour of the fixed-*i*-case or the fixed-$\tilde{p}$-case.[26] These arbitrage assumptions are very important as they imply where taxes can be effectively shifted, i.e., who bears the burden of a tax.

4 Comparison of Forward-Looking Measures and Approaches

4.1 Models Based on Neoclassical Investment Theory

By relying on an approach based on neoclassical investment theory, *King/ Fullerton* (1984) were the first who broadly computed effective marginal tax rates on investment in a number of countries. Their model became standard in international tax burden comparisons.[27] The *King/ Fullerton* (KF) approach is based on the assumption of an everlasting one unit increase of the capital stock. Under consideration of taxation, the pre-tax rate of return that is necessary to satisfy the minimum requirements by the shareholders is calculated. The difference between this rate of return $\tilde{p}$, the so-called cost of capital, and the marginal post-tax rate of return to the shareholder *s* is the tax wedge, and this wedge divided by the cost of capital is the effective marginal tax rate *EMTR*:

$$EMTR = \frac{\tilde{p} - s}{\tilde{p}} . \tag{4}$$

[26] See *King/ Fullerton* (1984), pp. 11-12; *OECD* (1991), pp. 89-90; for a critical view, see *Claassen* (1994), pp. 97-100.

[27] For some early and some more recent and extensive studies based on this framework, see *OECD* (1991); *European Commission* (1992); *Chennells/ Griffith* (1997); *Caron & Stevens/ Baker & McKenzie* (1999); *Hugounenq/ Le Cacheux/ Madiès* (1999); *Spengel* (1999); *Winner* (2000); *Baker & McKenzie* (2001); *Gutekunst/ Schwager* (2002).

The calculations are based on a very simple model cash flow. Thus the whole basic model is very compact and can be expressed by a few formulas.

To concentrate on conceptual issues, we will focus on the fixed-*i*-case and analyse a very basic model which only takes into account the most important parameters and assumes price stability.[28] For the tax system, we consider the statutory tax rate on corporate profits τ, the rate of imputation tied to a dividend c, the personal income tax rates on interest payments m^i, dividends m^d, and capital gains on the disposal of shares z, and a declining balance depreciation rate at ϕ. As economic parameters, we consider the real market interest rate i and the rate of economic depreciation δ. We regard the cases of an investment that is financed by retained earnings (RE), new equity (NE), or debt (D).

Then, the model can be specified by[29]

$$s = (1 - m^i) \cdot i; \tag{5}$$

$$\tilde{p}_{KF} = \frac{(1 - A) \cdot (\rho_{KF} + \delta)}{1 - \tau} - \delta \tag{6}$$

with

$$A = \tau \cdot \phi \cdot \sum_{u=0}^{\infty} \frac{(1 - \phi)^u}{(1 + \rho_{KF})^{u+1}} = \frac{\tau \cdot \phi}{\phi + \rho_{KF}}, \tag{7}$$

denoting the present value of the tax savings due to declining balance depreciation allowances and

$$\rho_{KF}^{RE} = \frac{(1 - m^i) \cdot i}{(1 - z)}; \tag{8}$$

$$\rho_{KF}^{NE} = \frac{(1 - c) \cdot (1 - m^i) \cdot i}{(1 - m^d)}; \tag{9}$$

$$\rho_{KF}^{D} = (1 - \tau) \cdot i; \tag{10}$$

denoting the discount rate ρ_{KF} for the each of the three different sources of finance.

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[28] For the model, see *King/ Fullerton* (1984), pp. 7-30. However, in contrast to *King/ Fullerton* we use a discrete time approach. Such an approach has also been applied by *OECD* (1991) and *European Commission* (1992).

[29] Readers interested in details on the derivation and the interpretation of the formulas are referred to *King/ Fullerton* (1984), pp. 7-30.

The *EMTR* is equal to the statutory tax rate when a comprehensive income tax system which is neutral with respect to the investment decision is supposed and personal taxes are included. If, on contrary, a consumption-based system such as a cash flow tax or an ACE-tax is supposed, the *EMTR* indicating investment neutrality would be zero.[30]

In 1998, *Devereux* and *Griffith* (DG) presented a model for computing effective marginal as well as effective average tax rates that is also based on neoclassical investment theory and builds on the *King/ Fullerton* approach.[31] The model has been applied in two studies evaluating the German tax reform of the year 2000[32] and in an extensive study on the effective levels of company taxation in the member states of the European Union[33].

As with the *King/ Fullerton* approach, again an incremental investment of one unit to the capital stock of a firm is assumed. In contrast to the former approach, this increment is reversed after one period. Also in opposition to the *King/ Fullerton* approach, the additional investment might earn an economic rent.

An effective average tax rate based on net present values $EATR^R$ can be defined as the difference between the pre-tax net present value R^* and the post-tax net present value R of the investment, divided by the present value of the income p generated by the project and discounted at the pre-tax interest rate i:[34]

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[30] See *King/ Fullerton* (1984), pp. 26-27; for effective marginal tax rates under a tax system based on an allowance for corporate equity, see also *Lammersen* (1999), pp. 82-85, 87-111.

[31] See *Devereux/ Griffith* (1999).

[32] See *Bond/ Chennells* (2000); *Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung* (2001), sections 372-385, 527-553.

[33] See *Devereux/ Lammersen/ Spengel* (2000); *European Commission* (2001).

[34] See *Devereux/ Griffith* (1999), p. 20. The model presented here follows the one employed by *Schreiber/ Spengel/ Lammersen* (2002) and is slightly different from the one presented by *Devereux/ Griffith* (1999). For details on the derivation and the interpretation of the formulas, see *Devereux/ Griffith* (1999), *Devereux/ Griffith* (2002), and *Schreiber/ Spengel/ Lammersen* (2002), pp. 6-13.

In short: The net present value computed by (13) consists of four parts. (1) The first summand in the braces denotes the change in the value of dividends due to the retention of one unit of profits $-\gamma$ and due to the value of tax deductions from depreciation allowances $\gamma \cdot A$. (2) The second summand consists (a) of the post-tax value of the surplus $\gamma \cdot (p + \delta) \cdot (1 - \tau)$. Reinvestment at the end of the period is reduced by $(1 - \delta)$, which moreover reduces tax deductions due to depreciation allowances. Thus (b) the second part of the second summand is $\gamma \cdot (1 - \delta) \cdot (1 - A)$. Both parts are discounted for one period. (3) The third summand, F, adjusts this formula to take into account cash-flows associated with external financing. Since distributions are the residual use of funds in the model, dividend payments increase when external funds are raised by the corporation and decrease when they are redeemed and when interest is paid. Expressions (17) and (18) take this into account. (4) The factor $(1 - z)$ finally takes into account an initial capital gains tax that is due in case of a positive net present value.

$$EATR^R = \frac{R^* - R}{p/1+i}. \tag{11}$$

The net present values under the basic economic framework mentioned above are

$$R^* = \frac{p-i}{1+i}, \tag{12}$$

$$R = \left\{ -\gamma \cdot (1-A) + \frac{\gamma}{1+\rho} \cdot \left[(p+\delta) \cdot (1-\tau) + (1-\delta) \cdot (1-A) \right] + F \right\} \cdot (1-z), \tag{13}$$

with

$$\gamma = \frac{(1-m^d)}{(1-c) \cdot (1-z)}$$

denoting a ratio which describes a discrimination factor between retained and distributed earnings, (14)

$$\rho = \frac{(1-m^i) \cdot i}{(1-z)} \tag{15}$$

denoting the discount rate of the shareholder and

$$F^{RE} = 0, \tag{16}$$

$$F^{NE} = \frac{-\rho \cdot (1-\gamma)}{(1+\rho)}, \tag{17}$$

$$F^D = \gamma - \frac{\gamma \cdot [1 + i \cdot (1-\tau)]}{1+\rho}, \tag{18}$$

denoting the additional present value F of financing by retained earnings, new equity, or debt.

With s and A being defined as in (5) and (7) and with ρ as defined in (15) as the discount factor, for $R = 0$ an *EMTR* can be computed by (4) with a cost of capital of

$$\tilde{p}_{DG} = \frac{(1-A) \cdot (\rho + \delta)}{1-\tau} - \frac{F \cdot (1+\rho)}{\gamma \cdot (1-\tau)} - \delta. \tag{19}$$

Additionally, an effective average tax rate based on rates of return can be calculated:[35]

$$EATR^{p} = \frac{p - r}{p}, \tag{20}$$

where the post-tax rate of return r is defined as

$$r = R \cdot (1 + s) + s. \tag{21}$$

With respect to the assumed model cash flow and the compactness of the formulas, the approach is comparable with the one by *King* and *Fullerton*. This becomes clearest when we compare the basic formulas for computing the effective marginal tax burdens. In fact, under a number of scenarios both expressions are equivalent. They only differ with respect to how external sources of finance are modelled in the calculation of the cost of capital. In the *King/ Fullerton* approach, this is taken into consideration by changing the discount rate ρ, whereas this rate is independent of the source of finance in the *Devereux/ Griffith* model, and a parameter F is added to capture the present value of the one-period external financing.

Consequently, in the basic model shown above the *EMTR* are the same regardless of the approach taken under a number of cases: For the expressions for the cost of capital to be equal, it is sufficient to assume that the investment is financed by retained earnings, or that there is a neutral depreciation schedule, or that the corporate tax system satisfies some basic neutrality conditions. This is shown in more detail in the appendix to this paper.

From the point of view of business management, the fact that the discount rate does not depend on the source of finance of the corporation appears to be preferable, as under the concept of shareholder value the discount rate is determined by the alternative, non-corporate use of funds for the shareholder. This alternative use of funds is assumed to be a financial asset that yields the market interest rate and is not affected by the way the corporation is financed. This particular feature of the *King/ Fullerton* approach has already been criticised – inter alia for these reasons – by *Scott*[36] and *Stellpflug*[37].

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[35] For more details, see *Schreiber/ Spengel/ Lammersen* (2002), p. 11.

[36] See *Scott* (1987), pp. 258-259.

[37] See *Stellpflug* (2001), p. 116.

Turning to the inframarginal case, the *King/ Fullerton* approach can no longer be applied. With respect to the comparability of the *EMTR* and the *EATR*, the $EATR^R$ developed by *Devereux/ Griffith* exhibits the shortcoming that it is based on net present values, not on rates of return as the one defined by *King* and *Fullerton*. However, for cases where only corporate taxes and dividend taxation are considered, *Devereux/ Griffith* have shown that the *EMTR* calculated on basis of their approach is a special case of the $EATR^R$, i.e. it is equal to the $EATR^R$ of the marginal investment.[38] Additionally, it can be shown that the $EATR^R$ is equal to the $EATR^p$ when the discount rate ρ and the post-tax marginal rate of return to the shareholder *s* are not affected. In this case, with $m^i = z = 0$, what implies that $s = \rho = i$, we obtain:[39]

$$EATR^R = \frac{R^* - R}{p/(1+i)} = \frac{\frac{p-i}{1+i} - R}{p/(1+i)} = \frac{p - [R \cdot (1+i) + i]}{p} = EATR^p \,. \tag{22}$$

In cases where the concepts based on net present values and rates of return differ, the measures cannot be compared with the *EMTR*. However, it has been shown that within this basic model, the $EATR^p$ for all parameter values is in fact a weighted average of the *EMTR* and a combined statutory tax rate which takes into account corporate taxation, dividend taxation and the taxation of capital gains:[40]

$$EATR^p = \frac{\tilde{p}}{p} \cdot \frac{\tilde{p} - s}{\tilde{p}} + \frac{p - \tilde{p}}{p} \cdot \left[1 - (1-\tau) \cdot \frac{1 - m^d}{1 - c} \cdot \left(1 - \frac{\rho \cdot z}{1+\rho} \right) \right] \tag{23}$$

$$= \frac{\tilde{p}}{p} \cdot EMTR + \frac{p - \tilde{p}}{p} \cdot \quad combined\ statutory\ tax\ rate \,. \tag{24}$$

For $p = \tilde{p} \Rightarrow EATR^p = EMTR$, thus we have the striking result that the *EMTR* is a special case of the $EATR^p$ and, with a view to the relationship between $\tilde{p}_{KF}$ and $\tilde{p}_{DG}$ shown above and in the appendix, the valuable property that for a

[38] See *Devereux/ Griffith* (1999), p. 21.

[39] See *Schreiber/ Spengel/ Lammersen* (2002), p. 15.

[40] For the $EATR^R$, see *Spengel/ Lammersen* (2001), pp. 227-228; *Devereux/ Griffith* (2002), p. 11. For the $EATR^p$, see also *Schreiber/ Spengel/ Lammersen* (2002), p. 14, who also give a more detailed explanation of the combined statutory rate mentioned. In short, the first two factors in the brackets encompass the combined corporate and personal tax rate on an additional unit of profits which is deemed to be distributed immediately. The last factor encompasses the taxation of the capital gain that arises due to an increased rate of profitability.

number of basic cases the $EATR^p$ is a more general expression of the *EMTR* as calculated by *King/ Fullerton*. The concept of the $EATR^p$ thus brings together the concepts by *King/ Fullerton* and *Devereux/ Griffith*.

One unattractive feature of the *Devereux/ Griffith* approach is the great weight that is given to dividend taxation when estimating the *EATR*. All proceedings generated by the investment are assumed to be distributed immediately. This might not be the optimal behaviour of an investor.[41] However, the whole model is not dealing with an endogenous optimisation of financial behaviour,[42] and as the three sources of finance at the beginning of the investment can be regarded in isolation, the absence of an internal mechanism of optimisation does not appear to be a big shortcoming. Nevertheless, at the end of the investment, it might be fruitful to isolate different strategies, i.e. uses of the funds generated.[43]

4.2 Model Firm Approach

Approaches based on model firms are especially common in business administration. They compute the consequences of taxation for particular projects in detail for each period. The tax bases are modelled in great detail and under consideration of liquidity effects.[44] The tax assessment and the effect of taxes on financial statements, liquidity calculations and profit and loss accounts are simulated over a number of successive periods. Based on these simulations, present values, final values, or effective rates of return are computed and compared by their absolute values or in relation to corresponding pre-tax values. To

[41] If the tax burden on corporate financial assets was lower than the one on non-corporate financial assets, an investor might increase wealth by accumulating funds inside the corporation. A first impression on whether such an effect exists can be gained by comparing the *EMTR* of a corporate financial asset financed by retained earnings with the benchmark of the effective tax burden on a non-corporate financial asset.

[42] Computing effective tax rates and costs of capital under a dynamic framework requires a number of additional assumptions; for some dynamic models, see *Sinn* (1987), *Weichenrieder* (1995).

[43] With respect to taxes at the corporate level only ($m^d = c = m^i = z = 0$), under most tax systems there is no difference between retained and distributed earnings, and the accumulation at the shareholder level is not regarded. Consequently, the implicit assumption of an immediate distribution is not relevant. If shareholder taxation is included, and assuming that any surplus can be invested in financial assets at the corporate level which yield the market interest rate, a modification of γ by adjusting m^d (and also of course c) might be a way of dealing with the issue. However, it might be very difficult to implement this properly, i.e. in a way that is consistent with the framework of the model.

[44] See *Spengel* (1995), pp. 159-203; *Jacobs/ Spengel* (1996), pp. 139-146, and (2000), pp. 339-340, who refer especially to the "*European Tax Analyzer*", a model firm approach developed by the *Centre for European Economic Research* (*ZEW*), Mannheim, and the *University of Mannheim*. For a recent study based on this model, see *European Commission* (2001); *Jacobs/ Spengel* (2002).

evaluate alternative projects or tax regimes, model firms with comparable characteristics are assessed under a number of different tax rules to investigate the differences in the tax burdens and to find out the most tax-preferred alternative.

In general, these instruments are applied for computing *EATR* only, although it is conceivable to calculate *EMTR* as well. These effective tax rates might be computed for an additional investment or for a whole business unit.

In addition to detailed model firm approaches, a number of particular studies on effective tax burdens apply less detailed calculations. These models, which exhibit a very partial character, might be applied to evaluate the tax consequences of very special situations. Thus they also might include non-periodic tax burdens, like the tax burden of a sale of the whole corporation or inheritance tax.

4.3 Comparison of Approaches

The used approaches show differences and similarities: In general, models based on neoclassical investment theory can be characterised as highly simplified and restricted model firm approaches.[45] The cash flows are determined in a fashion that they can be expressed in a very compact formula. This highlights the most important differences:

A model firm approach may contain an abundance of economic parameters, which cannot or only under great efforts be included in a model that is based on neoclassical investment theory. Examples are imperfect capital markets where interest rates for borrowing and for lending differ and time-variant economic parameters like inflation, real interest rates, excess cash flows, or distributions by the owner. Instead, models based on neoclassical investment theory build on a consistent but unrealistic economic framework. The logical consistency of the assumptions is ensured, but the results cannot be generalised arbitrarily.

Besides other issues, it might also be these inflexibilities that have led to the widespread use of models based on neoclassical investment theory. In the spirit of an ISO-norm[46] the basic assumptions are immediately clear to the user; they are the well-known assumptions of neoclassical investment theory. With model firms, on the contrary, especially if they are implemented in huge computer pro-

[45] For the *Devereux/ Griffith* approach, see e.g. the tables by *Schreiber/ Spengel/ Lammersen* (2002), pp. 8-10.

[46] For a similar metaphor, see *Schneider* (1988), p. 291.

grammes, the premises met are often not immediately clear. This can be overcome by a careful documentation of the model and by a systematic analysis of the impact of different economic assumptions on the results. Therefore, sensitivity analyses and what-if-analyses are very useful. However, neither neoclassical approaches nor model firm approaches can fully satisfy the claim to be universally valid.

As model firm approaches transform the economic environment more carefully, the tax consequences can also be implemented in more detail. Models based on neoclassical investment theory cannot or only in extremely special cases deal with progressive tax rates, loss compensation rules, the impact of taxation on dividend constraints established by corporate law or tax rules that change over time. This can be seen as a disadvantage, as these rules might have a strong impact on the effective tax burden.

4.4 Usefulness of Measures with Respect to Economic Issues

4.4.1 Introduction

To further illuminate these issues, we will rely on a simple example comparing two different but simple tax systems. An investor who faces a personal tax rate on interest income of $m^i = 40$ % and a real market interest rate of $i = 5$ % may choose, e.g. by deciding on the location, between two tax regimes for a real investment which depreciates at $\delta = 20$ %: The first one represents a cash flow tax with immediate depreciation ($A = \tau$) and a profit tax rate of $\tau = 40$ %. The second one represents a corporate income tax with neutral depreciation of marginal investments ($\phi = \delta$) and a profit tax rate of $\tau = 25\%$. There are no further taxes on dividends or personal capital gains. The investor finances the project by retaining earnings.

The upper half of figure 1 plots the impact of these tax regimes on the rates of return.

The abscissa defines the considered investment by its pre-tax rate of return. Supposing a downward-sloping marginal product of capital, as displayed by the downward sloping line of the pre-tax rate of return p, the further to the right the marginal investment is, the more investments are profitable.

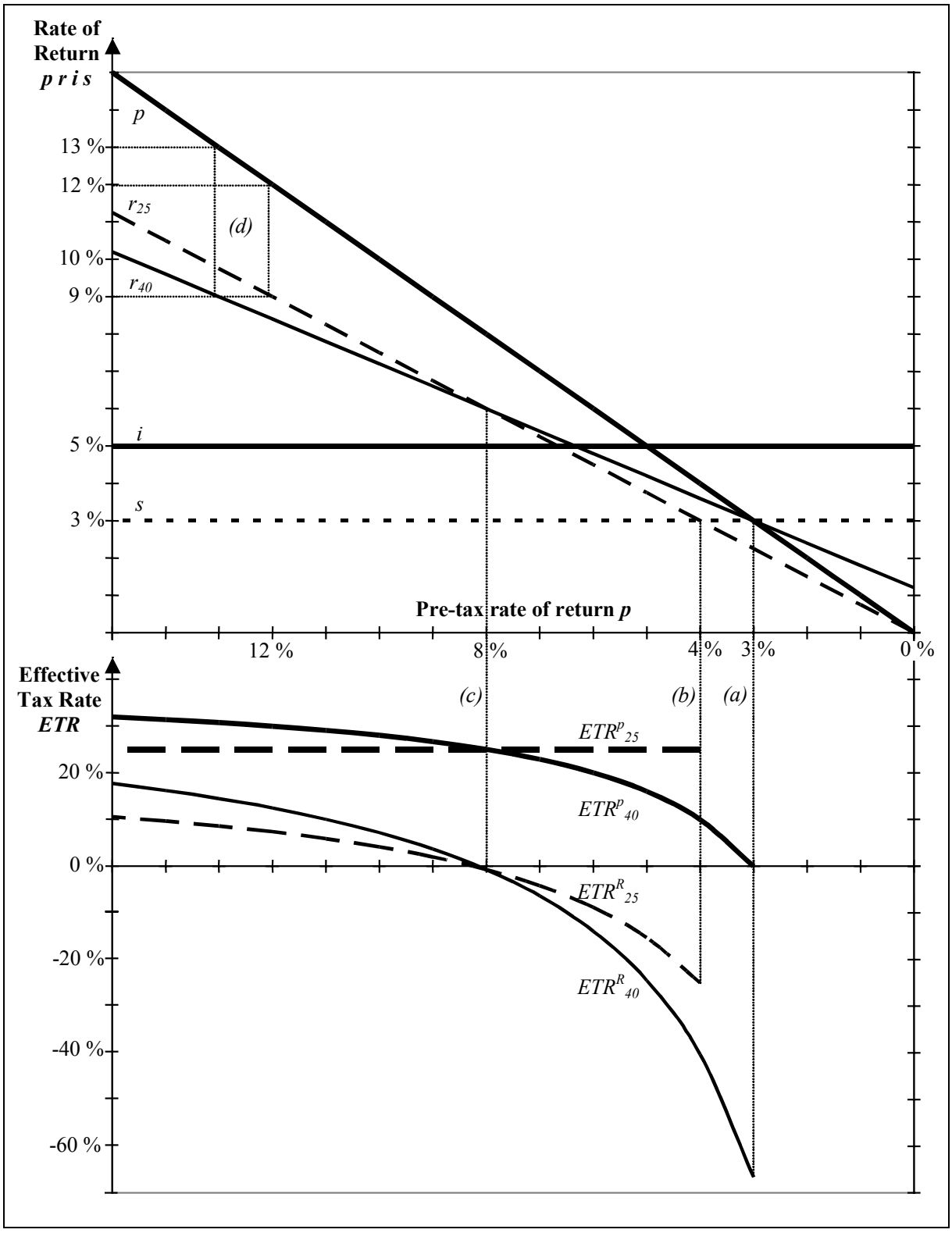

Figure 1: An Example of Rates of Return and Effective Tax Rates.

The ordinate contains the rates of return that are relevant for an investment that generates the pre-tax rate of return denoted by the abscissa. First, this is again the pre-tax rate of return p. Second, these are the two post-tax rates of return r_{40} and r_{25} an investment with a pre-tax rate of profitability of p would earn either

under the 40 %- or the 25 %-tax regime. Both lines are also downward sloping. A more favourable depreciation regime induces an upward shift of the post-tax rate of return, whereas the main effect of a lower tax rate is to increase the slope of the *r*-lines. Thus r_{40} is flatter than r_{25} while starting off from a higher level at $p = 0$. Third and fourth, the ordinate contains the real market interest rate *i* and the marginal post-tax rate of return to the shareholder *s*. Both are independent of the level of profitability and thus horizontal.

The lower half of figure 1 shows the effective tax rates (*ETR*) for each pre-tax rate of return under the two tax regimes. In addition to the effective tax rates based on rates of return ETR^p, also those based on net present values ETR^R are plotted. These effective tax rates are only shown for the area where an investment is inframarginal or marginal, i.e., its post-tax rate of return *r* is at least as high as the post-tax market rate of return to the investor *s*.

(a) Under the cash flow tax the cost of capital is 3 %. This implies an ETR^p_{40} of 0 %. The ETR^R_{40} is strongly negative, indicating that the post-tax net present value of zero exceeds the pre-tax net present value of the investment, which is negative, by large. As shown above, under these assumptions only the ETR^p equals the *EMTR* as calculated by the approaches of *Devereux/ Griffith* and *King/ Fullerton*, which are the same under the assumptions taken here.

(b) For the income tax, the advantage given by the low tax rate of 25 % translates into a cost of capital of 4 %. Again, taxation raises the net present value of the investment, and the ETR^R_{25} is negative. However, one quarter of the return on the investment is taken by taxation, thus the ETR^p_{25}, which equals the *EMTR*, is 25 %.

(c) The third important level of the pre-tax rate of return is 8 %. At $p = 8$ %, both tax systems result in a post-tax rate of return of 6 %. The investor would be indifferent between both tax regimes. This is also displayed by both concepts of the *ETR*, with $ETR^p_{40} = ETR^p_{25}$ and $ETR^R_{40} = ETR^R_{25}$. For rates of return below $p = 8$ %, the cash flow tax system is advantageous, for rates of return above, the income tax system is. This is due to the fact that the higher the rate of return of an investment, the more important becomes the statutory tax rate, and the relatively less important are the allowances which are based on the fixed initial cost of the investment and thus work like a

fixed payment by the government.[47] This is exhibited by the effective tax rates. The ETR^p tends from the *EMTR* towards the statutory tax rate τ for an increasing level of profitability, whereas the $EATR^R$ tends towards a value that is lower than the statutory tax rate due to the taxation of the alternative use of funds.[48] If dividends were taxed, the asymptotic value would also mirror dividend taxation. For a given pre-tax rate of return (fixed-*p*-case), the investor favours the investment with the lower *ETR* regardless of the measure.

(d) This leads us to finally focus on the so-called fixed-*r*-case for inframarginal investments. To obtain a post-tax rate of return of 9 %, the investment has to earn 12 % under the income tax regime and 13 % under the cash flow tax regime. The comparable values under the fixed-*r*-case are different from those under the fixed-*p*-case, but again the *ETR* of the unfavourable cash flow tax regime is higher than the one of the income tax regime.

Bearing this example in mind, we can now explore the usefulness of these indicators for different economic problems.

4.4.2 Decision-making

With respect to the investment decision, in economic theory the volume of capital invested depends on the marginal rate of return. For a given downward sloping investment schedule, the last unit invested has to earn the cost of capital at least. The higher the cost of capital, the less investment is undertaken.

Indirectly, this can also be shown by the *EMTR*. An *EMTR* below the statutory tax rate on interest income m^i indicates overinvestment, an *EMTR* above this rate indicates underinvestment. The statutory tax rate on interest income, which is 40 % in the example, is thus the benchmark for economic distortions under these assumptions. It also delivers a standard measure indicating whether the definition of the tax base or a system of corporate taxation disadvantages an investment. Under some basic assumptions,[49] the *EMTR* calculated from (4), (5) and (19), i.e. following the *Devereux/ Griffith* approach, also fulfils the fourth

[47] For a more detailed investigation, see *Devereux/ Griffith* (1999), pp. 21-23; *Schreiber/ Spengel/ Lammersen* (2002), pp. 15-16.

[48] See in detail *Devereux/ Griffith* (2002), p. 11; *Schreiber/ Spengel/ Lammersen* (2002), pp. 15-16.

[49] These include the assumptions of the basic model above and a given tax rate on personal interest income m^i.

proposition mentioned in section 3.3 in case of equity-financed investments. An advantage given by a generous tax base or a favourable corporate tax system is equal to a systematic variation of the statutory tax rate under a neutral definition of the tax base and a neutral corporate tax system for the marginal investment.[50]

The tax systems mentioned above both lead to a distortion with respect to the level of investment as the cost of capital in both cases is below the market interest rate. Overinvestment is greater in the cash flow tax regime than in the income tax system, causing a greater excess burden of taxation.[51]

For a business manager, the cost of capital shows the minimum rate of return an additional investment has to earn.

Turning towards discrete investments, the *EATR* is the relevant measure of the effective tax burden. The cost of capital is only relevant to prove whether at least one of the alternatives offers a non-negative post-tax net present value, which is the case if the investment's pre-tax rate of return is not below its cost of capital.

For a fixed pre-tax rate of return, an investor chooses the investment with the lowest *EATR* to obtain the greatest net present value or pre-tax rate of return. For a given post-tax rate of return, different *EATR* indicate different pre-tax rates of return that are necessary to obtain this post-tax rate of return. The greater the positive or negative differences to the *EATR* of a given alternative, the greater the potential economic distortions. To prove an economic inefficiency, only the fixed-*r*-case would be suited. Under the fixed-*p*-case, there would be no inefficiency, as by definition each of the alternatives would be similarly efficient. However, the fixed-*p*-case already gives strong evidence on potential economic distortions. Different *EATR* remove the indifference that would prevail if taxes were not considered, thus inefficiencies can be expected already for slight differences in the pre-tax rates of return.

For the *EATR*, a standard measure for the effective tax rate is less important than it is for the *EMTR*. The comparison to the tax treatment of a financial asset is less meaningful, as a limited number of profitable alternatives should be compared and one of them should be selected. The issue is not how much can

[50] See *Schreiber/ Spengel/ Lammersen* (2002), pp. 15-16.

[51] The excess burden can be depicted exemplarily by the triangles in the upper half of figure 1 between the *i*-line, the *p*-line, and a vertical line at the intersection of the *r* and the *s*-line of the tax regimes.

be invested in a single alternative until the last unit invested earns the minimum required return. Under equal non-tax parameters, the alternative which exhibits the lowest *EATR* will exhibit the highest post-tax net present value and thus be the most advantageous with respect to its tax treatment. However, by fulfilling the properties mentioned in section 3.3, an *EATR* would be easier to communicate and the tax drivers might be identified more easily. The $EATR^p$ fulfils these properties under the same assumptions as mentioned above for the *EMTR*.

Empirically and theoretically, it has been shown that the *EATR* is very relevant for international location decisions.[52] Referring to the example in section 2.2.1, if an investor expected post-tax economic rents of 4 (A), 7 (B), and 5 (C), the investor would choose country B and there would be a welfare loss of 2 if country A could not offer its economic rent to somebody else, i.e., if the economic rent could only be exploited by country A and the particular investor together.

For a business manager, the fixed-*r*-case might also show some kind of hurdle rate. If an investor had to weigh up a location which offers a higher pre-tax rate of return and another one which offers a more favourable tax regime, he might conclude on the size of the extra rate of return necessary to outweigh the more favourable tax system. However, it is necessary to set a reference case, which may be difficult to choose. The problem compared with a situation of marginality is that there is no natural benchmark when deciding between mutually exclusive investments that earn an economic rent.

If the favourability of certain investments is assumed to depend not only on rates of return or net present values, but also on liquidity and the availability of funds, the $EATR^R$ might point at the impact of taxation on net present values and thus the credit standing connected with an additional investment. Ceteris paribus, net present values rise when generated net cash flows increase or when the alternative use of funds is taxed more heavily. Thus measures based on net present values can only be a proxy for a greater cash flow if the discount rate is not affected. On the contrary, $(1 - EATR^p)$ might be a proxy for the net cash flow generated by an additional profitable investment and thus the availability of internal sources of finance.

[52] See *Devereux/ Griffith* (1998), pp. 353, 362; *Bond* (2000), pp. 171-172; *Devereux* (2000), p. 113; *Richter/ Seitz/ Wiegard* (1996), p. 19.

However, it should be noted that the assumptions taken by the approaches based on neoclassical investment theory are not consistent with liquidity effects of taxation, as they suppose perfect capital markets with a single market interest rate. Thus studies based on model firms might be more suited to evaluate these issues. Here, liquidity effects can be implemented as a side condition or as a part of the goal variables.

This idea is supported by the view that an enhanced liquidity rather depends on an *EATR* in the sense of the effective tax burden on a whole business unit, as opposed to the one on an additional investment.[53] As model firm approaches might consider whole business units, these approaches might capture such effects.

With respect to the impact of taxation on financing decisions, for most tax systems it appears to be sufficient to consider the marginal case. Usually, differences in taxation with respect to different sources of finance are caused by the corporate tax system or by the definition of the taxable base. These differences are fully mirrored in the cost of capital and the *EMTR*, as (4), (19), (23), and (24) show. The tax-efficient source of finance for a marginal investment is thus in principle[54] always the tax-efficient source of finance of any profitable investment, regardless of the level of profitability.

From the point of view of a business manager, this information can be used for tax optimisation schemes based on choosing the source of finance that offers the lowest cost of capital.

From an economic point of view, differences in the cost of capital of different sources of finance might identify desired or undesired distortions and the potential whether there is at least one source of finance that is neutrally taxed and thus may serve as a buffer which absorbs effects of taxation on real investment.

If one deems liquidity effects as more relevant for financing decisions than effects on profitability,[55] the remarks on liquidity effects mentioned above also apply to financing decisions.

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[53] See *Fazzari/ Hubbard/ Petersen* (1988); *Jacobs/ Spengel* (1994), p. 200; *Hubbard* (1998), p. 219.

[54] Deviations from this rule might e.g. occur if the profits from an investment that is financed by a particular source of finance are taxed at a lower tax rate.

[55] See e.g. *Schneider* (2002), p. 175.

4.4.3 Competition

With respect to competition, we need to take an interpersonal point of view. If we assume the selling price to be the parameter for competition, the effective level of taxation might be an indicator of competitiveness inasmuch as the rate of profitability is directly tied to the selling price. If the competitor with the lowest potential price wins the competition for serving the market with the proceeds of one additional invested unit, the cost of capital can act as an indicator for competition issues. The *EMTR* cannot be applied to explore the competitiveness if individuals face different personal tax rates on interest payments. This is the case because under high interest taxation coming with a high level of company taxation, the *EMTR* might be high whereas the cost of capital might be low.

Ceteris paribus, a company facing a cost of capital of 3 % might place a lower bid than a company that faces a cost of capital of 4 %. Again, due to the ceteris paribus assumption, one cannot draw a direct conclusion on whether a firm that was less competitive before taxes were taken into account displaces a more competitive one, causing a welfare loss.

If competitiveness is also affected by liquidity, effective average tax rates become relevant. The issues mentioned in the previous subsection also hold true here. The results from neoclassical approaches might be valuable indications when carefully interpreted, and model firm approaches might be better suited in this case than approaches based on neoclassical investment theory.

4.4.4 Distributional Aspects

To assess distributional issues, the usefulness of the indicators based on neoclassical investment theory is very limited. We can only gather some first tendencies by relying on these approaches.

Each of the investment, financing and competition issues mentioned above has an impact on the relative income of the individuals who reap the fruit of the projects, i.e., one has to allow for discretionary space for the investors to tax optimise their behaviour. Then the *EMTR* and the $EATR^{p}$ might give an impression on the part of the proceeds from an extra unit of investment that is taken by taxation.

The $EATR^R$ displays the ranking of post-tax net present values. However, as net present values strongly depend on the taxation of the marginal investor and thus the alternative use of the funds, international comparisons for individuals with different personal tax rates and thus different opportunity costs might be misleading.

As already mentioned, net present values increase with lower opportunity costs of investment. An increase in the personal tax rate on interest income of the marginal shareholder thus boosts share values, even though the cash flows generated within each period might be exactly the same as before. If the shareholder sells the share, he will be better off than before, but if he keeps it forever, wealth increases only on paper, and the shareholder will not be any better off. A tax system that puts an equivalent burden on the opportunity cost of an investment as on the investment itself[56] would not change the present value of the investment, but the present value of taxes paid would obviously be positive.

Other limitations result from the fact that the models based on neoclassical investment theory only regard one factor and do not consider complex mechanisms of tax incidence. Furthermore, they only consider additional investments, not the tax burden on the whole income of an individual. Model firm approaches can take into account a number of additional relevant issues, e.g. personal allowances. They might therefore be better suited for the investigation of distributional aspects.

5 Summary and Conclusions

Effective tax rates are a useful tool for economists, policy makers and business managers who demand condensed but sophisticated information on effective tax burdens. Business managers are generally interested in post-tax measures of performance, while economists rather need to know the differences in pre-tax measures, as these differences indicate distortions and welfare losses. However, to predict the behaviour of economic agents, economists have to model the behaviour of managers. Thus they also have to consider post-tax performance.

The most important task of the measurement of effective tax burdens is to identify relative differences in tax burdens and the tax drivers that are responsible

[56] This is true for the tax system outlined by *Johansson* and *Samuelson*, see section 3.2.

for them. For the identification of these tax drivers and for the communication of the results, it is very helpful if the measure of the effective tax burden exhibits some properties that permit a comparison with the statutory tax rate under a neutral tax system.

A number of different approaches for measuring effective tax burdens on capital income exist. This variety helps solving a number of different economic issues. However, not all approaches are equally suited for all problems. For the measurement of forward-looking effective tax burdens, we first need to determine whether the effective marginal or the effective average tax burden is the relevant measure for the question to solve.

The effective marginal tax burden is relevant if investment projects are assumed to be arbitrarily divisible and the investor can always invest the exact amount to equalise the post-tax rates of return of all alternatives. Effective marginal tax rates (*EMTR*) are suited to evaluate whether a tax system follows its systematic foundations and to show allocation effects. Furthermore, they can be applied for investigating tax effects on financing decisions. The cost of capital, which is closely related to the concept of the marginal tax burden, can be employed when analysing the effects of taxation on competitiveness.

The effective average tax burden is relevant if there is a choice of a number of profitable, mutually exclusive projects. A classic example for this situation is the choice of location. Under a number of limitations, effective average tax rates (*EATR*) can also be relevant for liquidity aspects and distributional aspects of taxation. Relative differences in the *EATR* are more important than their absolute values.

The elements of the tax base and the tax rate enter the results of *EMTR* and *EATR* with different weights: For the *EMTR*, tax rules with respect to the definition of the tax base are more important than for the *EATR* as long as they are based on the initial cost of the asset and not on the level of profitability. The same would be true for other tax rules that are tied to the initial cost of an investment, e.g. wealth or property taxes based on historic costs. For the *EATR* the statutory tax rate, which is also important for the *EMTR*, is more important. Thus both measures might lead to different results when applied to the same tax system or issue. A meaningful measurement of effective tax burdens therefore supposes that the purpose of the measurement and thus the basic question to be solved is revealed.

Once it is clear which of the two measures should be calculated, a second step should consider the theoretical approach. We can differentiate between models based on neoclassical investment theory (*King/ Fullerton* and *Devereux/ Griffith*) and approaches based on model firms. The former have been preferred in economics, the latter in business management. However, both concepts have common roots. Models based on neoclassical investment theory can be regarded as special cases of model firm approaches under very strong assumptions.

The approaches by *King/ Fullerton* and *Devereux/ Griffith* differ in details. The latter should be preferred in case the *EATR* should be calculated in addition to the *EMTR*. By computing an *EATR* based on rates of return, the consistency between effective marginal and effective average tax rates can be secured.

In case only *EATR* are of interest, model firm approaches are the more preferable, the more detailed the economic framework and the tax system need to be modelled.

Figure 2 finally depicts this choice.

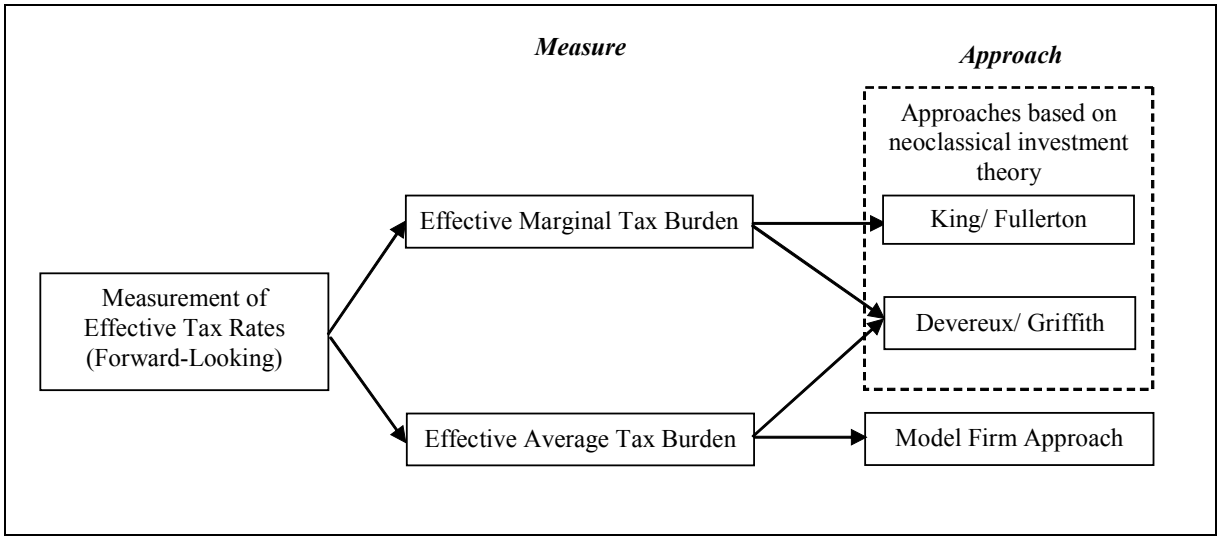

Figure 2: Measures and Approaches for the Calculation of Forward-looking Effective Tax Rates.

Appendix

To show the conditions for an equivalence between the *King/ Fullerton* and the *Devereux/ Griffith* approach, it is sufficient to show the equality between the cost of capital calculated under both approaches. This is because the expression for the post-tax rate of return for the shareholder *s* is the same in both models.

We find some general cases[57] where both approaches yield the same numerical results for the *EMTR*:

Case 1: The investment is financed with retained earnings.

$$F = 0;\ \rho = \rho_{KF}^{RE} \Rightarrow \tilde{p}_{DG} = \tilde{p}_{KF} = \frac{(1-A)\cdot(\rho+\delta)}{1-\tau} - \delta\,. \tag{25}$$

Case 2a: Neutral corporate income tax system with $m^i = \tau$, $m^d = c$, and $z = 0$.

$$\gamma = 1;\ \rho = \rho_{KF} = (1 - m^i)\cdot i \Rightarrow F = 0 \Rightarrow \tilde{p}_{DG} = \tilde{p}_{KF} = \frac{(1-A)\cdot(\rho+\delta)}{1-\tau} - \delta\,. \tag{26}$$

Case 2b: Debt financing and equal tax rates on corporate profits and personal interest payments ($m^i = \tau$), no capital gains taxes. This can be regarded as a special case of case 2a, as for debt-financed marginal investments the taxation of dividends is irrelevant.

$$\rho = \rho_{KF}^{D};\ F = 0 \Rightarrow \tilde{p}_{DG} = \tilde{p}_{KF} = \frac{(1-A)\cdot(\rho+\delta)}{1-\tau} - \delta\,. \tag{27}$$

Case 3: Non-neutral corporate tax system, but neutral depreciation for tax purposes ($\phi = \delta$). In this case, only the distortions caused by the corporate tax system remain. For debt financing, there is no such distortion in the basic model.

New equity: $$\tilde{p}_{DG} = \tilde{p}_{KF} = \frac{(1-c)\cdot(1-m^i)\cdot i}{(1-m^d)\cdot(1-\tau)}; \tag{28}$$

Debt: $$\tilde{p}_{DG} = \tilde{p}_{KF} = i\,. \tag{29}$$

[57] There are more cases which are less general, i.e. need more common parameter specifications, but where both approaches in principle obtain the same results, e.g. the case of a cash flow tax with $A = \tau$, $m^d = m^i = z = 0$ and non-deductibility of interest payments at the corporate level. This would result in $\tilde{p}_{DG} = \tilde{p}_{KF} = i$.

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