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Measuring Corporate Tax Avoidance – An Analysis of Different Measures

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Abstract

This study (1) gives an overview of and analyzes the different existing measures of tax avoidance in the empirical tax research literature and (2) aims at answering the question of how closely related they are in measuring corporate tax avoidance. Starting with a theoretical comparison of different Effective Tax Rate based measures, Book-Tax-Differences based measures, the measure developed by Henry and Sansing (2014), Tax Shelter Scores, and Unrecognized Tax Benefits an empirical comparison of the first three mentioned measures is conducted. The purely descriptive analysis reveals that although there are differences between the single measures and those differences persist over time, especially annual proxies exhibit considerable correlation, which increases with similarity in computation and inputs used. A comparison of annual with long-run measures implies that the reliability of annual measures in depicting long-run tax avoidance is not sufficiently high.

Keywords: tax avoidance, tax sheltering, Effective Tax Rate, Book-Tax-Difference

1. Introduction

Corporate tax avoidance has been and still is an important issue discussed in public media and politics. The U.S. Treasury Department Secretary, Lawrence H. Summer, characterized tax avoidance in 2000 as "what may be the most serious compliance issue threatening the American tax system today" (U.S. Department of the Treasury (2000)). Nowadays, sixteen years later, data leak scandals such as the "Luxembourg Leaks" in 2014 (see The Guardian (2015); Houlder (2014)) or most recently the "Panama Papers" in 2016 (see Lipton and Creswell (2016)) still reveal massive tax avoidance by corporations as well as individuals. Every year, the loss in tax revenue in the EU due to corporate tax avoidance is estimated from 50 to 70 billion Euros (Dover et al. (2015), p. 16). The U.S. Treasury estimates the loss in tax revenue due to tax sheltering (an aggressive form of tax avoidance) to 10 billion dollars annually (U.S. Department of the Treasury (1999), p. 31). To tackle the problem of corporate tax avoidance there have been actions made by supranational organizations such as the Base Erosion and Profit Shifting Project (BEPS) by the OECD/G20 or the Anti Tax Avoidance Package by the EU, which try to combat corporate tax avoidance on a global scale.[1]

Besides the social and political interest in, and the development of, actions against corporate tax avoidance, there has also been increasing theoretical and empirical research concerning corporate tax avoidance.[2] Prevalent interests of research in this context are the reasons, drivers, determinants, and implications of tax avoidance for firms and their shareholders. One of the main challenges these empirical studies face is the measurement of corporate tax avoidance since firms have strong incentives not to disclose their tax avoidance activities (Desai and Dharmapala (2009a), p. 539; Wilson (2009), p. 970). Therefore, over the decades, several different proxies for tax avoidance have been created, all of which are argued to have different properties and face different limitations.

Facing those numerous proxies, uncertainty may arise about which measure to choose. To give guidance for researchers in picking the right measure(s) for their research, this bachelor thesis aims to (1) give an overview of and analyze the different measures of tax avoidance existing in the literature and (2) answer the question of how closely related they are in measuring corporate tax avoidance. Because most international tax research refers to the U.S., the focus in this

[1] For information about the BEPS project see the webpages of the Organisation for Economic Co-operation and Development (OECD) (2016). For information on the Anti Tax Avoidance Package see the webpages of the European Comission (2016).

[2] For an overview of the empirical tax research see Shackelford and Shevlin (2001) and Hanlon and Heitzman (2010).

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thesis is therefore on the U.S. GAAP accounting environment.

The structure proceeds as follows: Section 2 and 3 define the term "tax avoidance" and give guidance on the choice of data sources used as inputs for the measures. In Section 4 the different measures are introduced and their properties and limitations are discussed theoretically. The focus lies thereby on Effective Tax Rate based measures, a measure of Henry and Sansing (2014), Book-Tax-Difference measures, Tax Shelter Scores, and the idea of Unrecognized Tax Benefits. Next, Section 5 analyzes and compares the different measures empirically. The analysis is purely descriptive in nature and compares annual measures among one another and furthermore examines their relationship with long-run measures. Section 6 concludes. Overall, it is found that, although the different measures of corporate tax avoidance do exhibit differences and those differences persist over time, measures based on the same rationale (such as Effective Tax Rate measures) are subject to large correlation among one another. The comparison of annual and long-run measures shows that annual measures may not be sufficient predictors of long-run tax avoidance.

2. Corporate Tax Avoidance

Before making attempts to measure corporate tax avoidance one needs to define the term first. According to many textbooks tax avoidance refers to the minimization of tax liability within the framework of the law, in contrast to tax evasion, which refers to minimizing tax liabilities including fraud (Miller and Oats (2014), pp. 15–16; Dover et al. (2015), p. 18).

Unfortunately, there is neither such a precise nor one single prevalent definition of tax avoidance in the field of tax research. This means that several different definitions of the term are used, depending on the research question and the means to measure avoidance. Hanlon and Heitzman, for instance, define "tax avoidance broadly as the reduction of explicit taxes" (2010, p. 137). According to Chen et al. (2010) tax avoidance or tax aggressiveness includes "tax planning activities that are legal, or that may fall into the gray area, as well as activities that are illegal. Thus, tax aggressive activities do not necessarily indicate that the firm has done anything improper" (2010, pp. 41–42). And Tang and Firth define "tax management, tax planning, tax avoidance, or tax shelter as taxpayers exploiting uncertainty in tax law to choose an advantageous method in tax reporting that influences their tax liabilities" (2011, p. 176).

As one can see, tax avoidance cannot be defined as precisely for tax research purposes as some of the textbooks suggest. In this context Hanlon and Heitzman (Hanlon and Heitzman (2010), p. 137) speak of a broad continuum of actions that can be classified as tax avoidance, which ranges from tax favored investments on one end to evasion and sheltering on the more aggressive end. This bachelor thesis follows the definition of Hanlon and Heitzman (2010); defining tax avoidance very broadly reflects that the following measures do not differentiate between legal or illegal tax avoidance (not even intentionally or unintentionally) and thus measure a whole range of activities that reduce the tax burden as avoidance. In the following the terms "tax avoidance", "tax aggressiveness", "tax management" and "tax planning" are all used simultaneously and "tax sheltering" is defined as a particularly aggressive form of tax avoidance.

3. Data Sources for Measuring Corporate Tax Avoidance

For measuring corporate tax avoidance one needs information about taxable income and tax liabilities (Salihu et al. (2013), p. 415) as well as financial statement data. The latter one is readily available (at least for publicly traded firms), while the two former ones are less available. Potential information sources for the required inputs are either financial statements of the company or its tax returns. While tax returns should contain the most accurate inputs of taxable income and tax liabilities, access to such information is limited since tax returns are confidential and thus can only be used by a few people (Salihu et al. (2013), p. 415). Alternatively, taxable income and tax liabilities can be estimated from financial statements by grossing-up the current tax expense (as developed by Manzon Jr and Plesko (2002), p. 188). To estimate taxable income, current tax expense is therefore divided by the statutory tax rate[3]:

$$taxable\ income = \frac{current\ tax\ expense}{statutory\ tax\ rate} \tag{1}$$

(Manzon Jr and Plesko (2002), p. 188)

However, this could lead to a poor estimate of the actual taxable income. As Hanlon's answer to the title of her paper "What Can We Infer about a Firm's Taxable Income from Its Financial Statements?" "The short answer: Usually not much" (Hanlon (2003), p. 831) suggests, there are several problems with estimating taxable income from financial statement data. She identifies three main reasons, why simply grossing-up current tax expense may lead to wrong estimates: (1) Current tax expense is likely to be over- or understated in comparison to the actual tax liability.[4] (2) Grossing-up using the top statutory tax rate will lead to wrong estimates of worldwide taxable income for multinational corporations doing business in several countries and therefore facing different tax rates. (3) In case of tax losses, current tax expense will usually be truncated at zero (Hanlon (2003)).

[3] Note that the statutory tax rate is assumed to be the top federal corporate income tax rate for the U.S. of 35 percent (see KPMG (2016); PWC (2016)), which is widely used in the tax research literature (Hanlon (2003), p. 844).

[4] According to Hanlon, the main reasons for an overstated current tax expense are the differential treatment of nonqualified employee stock options in financial accounting and tax accounting and the "tax cushion" which is incorporated into the current tax expense. Further, current tax expense could be understated because it only captures taxes on continuing operations but not on discontinued operations and extraordinary expenses (benefits), and thus does not reflect the tax on all types of earnings (Hanlon (2003), pp. 838–843). For the effect of employee stock options on the current tax expense see also Hanlon and Shevlin (2002).

However, since tax returns can only be accessed by a few people, and additional disclosures would be necessary to develop a better measure of taxable income, estimating it by grossing-up is a widely used practice (Hanlon (2003), p. 832, 843). Nonetheless one needs to keep these limitations in mind when using such estimates as inputs in measures of corporate tax avoidance. Especially measures based on Book-Tax-Differences may suffer from incorrect estimates as described below.

4. Measures of Corporate Tax Avoidance

In the tax research literature several different measures of tax avoidance have been developed and used. These measures differ with respect to the underlying rationale of measuring tax avoidance.

The purpose of this section is to give an overview of the proposed measures in the literature as well as analyze them in terms of validity and performance as measures of corporate tax avoidance.

4.1. Effective Tax Rate Based Measures

The first approach relies on the Effective Tax Rate (ETR). The Effective Tax Rate is basically the average tax rate a corporation pays on its pre-tax profits and is calculated by dividing a measure of tax liability by a measure of pre-tax income (Hanlon and Heitzman (2010), p. 139; Gupta and Newberry (1997), p. 1).

$$ETR = \frac{measure\ of\ tax\ liability}{measure\ of\ pre-tax\ income} \tag{2}$$

ETR based measures can be compared with the statutory tax rate. If an ETR measure is below the statutory tax rate, this could signal tax avoidance.

The ETR can be calculated based on different measures of tax liability (total tax expense, current tax expense, cash tax expense)[5] and pre-tax income, and can vary in terms of periods included in the measure. Broadly, one can differentiate between annual ETR measures and long-run ETR measures.

4.1.1. Annual ETR Measures

GAAP ETR

The basic form of annual ETR measures is the annual GAAP Effective Tax Rate (GAAP ETR), which is disclosed by firms in their financial statements (Dyreng et al. (2008), p. 65). It is defined as:

$$GAAP\ ETR = \frac{total\ tax\ expense}{pre-tax\ income} \tag{3}$$

(Dyreng et al. (2008), p. 65; Chen et al. (2010), p. 46; Dyreng et al. (2010), pp. 1168–1170)[6]

This basic form of ETR suffers from several severe limitations. Dyreng et al. (Dyreng et al. (2008), p. 65) criticize the GAAP ETR for not measuring tax deferral strategies (so do Hanlon and Heitzman (2010), p. 139 and Salihu et al. (2013), p. 416). They argue since total tax expense incorporates both current and deferred tax expense, but tax deferral strategies will reduce current tax expense and simultaneously increase deferred tax expense, these tax planning activities will not have any influence on GAAP ETR. Furthermore, the reliance on pre-tax income in the denominator limits GAAP ETR to non-conforming tax avoidance[7] (Badertscher et al. (2015), p. 6; Hanlon and Heitzman (2010), pp. 139–140; Salihu et al. (2013), p. 416). Thus, GAAP ETR would, for instance, not capture the tax effects of interest deductibility, because this reduces both taxable and financial income (Hanlon and Heitzman (2010), p. 141). Due to these limitations it becomes clear, that the GAAP ETR does not measure a considerable portion of tax avoidance.

Moreover, GAAP ETR does not distinguish between reductions in tax liabilities due to actual tax planning strategies and other "accidental" reductions (e.g. changes in valuation allowances) not associated with tax considerations. In fact every reduction of the explicit tax liability will alter GAAP ETR (Hanlon and Heitzman (2010), pp. 139–141).

Furthermore, the high volatility in GAAP ETR due to the use of annual data (Dyreng et al. (2008), p. 65) makes long-term predictions difficult. There is also a significant truncation bias of GAAP ETR rates (Henry and Sansing (2014)). This truncation bias results when pre-tax income is negative, in which case researchers usually drop loss years (Henry and Sansing (2014), p. 2; Wilkie and Limberg (1993), p. 49) since the interpretation of negative ETR is difficult. According to Henry and Sansing (Henry and Sansing (2014), p. 3) this practice also leads to an asymmetrical treatment of income and loss years, which may distort the results. Because of these shortcomings, there have been attempts to modify the GAAP ETR in order to increase the power of Effective Tax Rate measures.

Current ETR

To overcome the limitation of the GAAP ETR only measuring permanent tax avoidance, one could use current tax expense in the numerator instead which yields the Current Effective Tax Rate (Current ETR) measure (Salihu et al. (2013), p. 416):

$$Current\ ETR = \frac{current\ tax\ expense}{pre-tax\ income} \tag{4}$$

[5] To guarantee consistency with the empirical part of this thesis the definitions for these items are in line with those provided by the Compustat database. Therefore, total tax expense includes all income taxes imposed on the firm, current tax expense represents the current amount of taxes payable by the firm and cash taxes paid is the sum of all income taxes actually paid by the firm (Wharton Research Data Services (2016b)).

[6] The annual GAAP ETR is used, for instance, in studies by Chen et al. (2010), Dyreng et al. (2010), Armstrong et al. (2012), or .

[7] Non-conforming tax avoidance refers to tax planning strategies that result in a decrease in taxable income, while leaving financial income unaffected. Conforming tax avoidance reduces both taxable and financial income (Badertscher et al. (2015), p. 1).

(Salihu et al. (2013), p. 416)[8]

This variation allows measurement of tax deferral strategies (Salihu et al. (2013), pp. 416–417), because a reduction in current tax expense will not get compensated by an increase in the deferred tax expense, as this was the case using total tax expense (as described above). However, besides the enhancement in measuring tax deferral strategies, the Current ETR measure suffers from the same problems as the GAAP ETR. Additionally, as already described in Section 3 current tax expense may be over- or understated in comparison to the actual tax expense (Hanlon (2003), p. 831), which may distort the Current ETR.

Cash ETR

A further variation of annual ETR is the Cash Effective Tax Rate (Cash ETR), defined as:

$$Cash\ ETR = \frac{cash\ taxes\ paid}{pre-tax\ income} \tag{5}$$

(Chen et al. (2010), p. 46; Dyreng et al. (2010), p. 1169)[9]

Using cash taxes paid in the numerator instead of total or current tax expense makes the measure robust to changes in estimates as, for example, in the valuation allowances (Dyreng et al. (2008), p. 66). It also takes into account the tax effects of employee stock options (Dyreng et al. (2008), p. 66; Chen et al. (2010), p. 48), one main factor identified by Hanlon (2003) resulting in an overstatement of current tax expense, and thus is not subject to overstatement in this matter.

On the other hand, cash taxes paid could also include tax payments of former periods as it includes all taxes paid in one year regardless of which periods they actually arose in (e.g. tax payment related to an IRS audit of former years), which could lead to a mismatch of numerator and denominator and thus distort the Cash ETR (Hanlon and Heitzman (2010), p. 139; Dyreng et al. (2008), pp. 66–67). As in the case of Current ETR, Cash ETR also suffers from the remaining problems of GAAP ETR, not fixed by using cash taxes paid.

Cash flow based ETRs Another though less frequently used alternative to GAAP ETR (using pre-tax income) is the application of operating cash flows in the denominator. This yields measures such as total tax expense over operating cash flow (further called CFM1) (as used in Zimmerman (1983); Salihu et al. (2013)) or cash taxes paid over operating cash flow (further called CFM2) (as used in Salihu et al. (2013))

$$CFM_1 = \frac{total\ tax\ expense}{operating\ cash\ flow} \tag{6}$$

(Zimmerman (1983), pp. 122–123; Salihu et al. (2013), p. 417)

$$CFM_2 = \frac{cash\ taxes\ paid}{operating\ cash\ flow} \tag{7}$$

(Salihu et al. (2013), p. 418)

Although CFM_1 is not impacted by accrual accounting in the denominator, it still is subject to accrual effects in the numerator by using total tax expense and thus only measures non-conforming tax avoidance (Salihu et al. (2013), p. 417). CFM_2 solves this problem by using cash taxes paid. Therefore, it is argued that cash taxes paid over operating cash flow is able to measure conforming tax avoidance (Salihu et al. (2013), p. 418). The remaining problems associated with the total/cash tax expense are also applicable to the CFM_1 and CFM_2.

4.1.2. Long-Run ETR Measure

To overcome some of the previously discussed limitations of the annual ETR measures, Dyreng et al. (2008) develop a measure called Long-run Cash Effective Tax Rate (Long-Run Cash ETR / lr. Cash ETR). They define their measure as the sum of cash taxes paid over a long period of time (e.g. ten years) divided by the sum of pre-tax income (excluding special items) over the same time period:

$$Long-Run\ Cash\ ETR = \frac{\sum_{t=1}^{N} cash\ taxes\ paid_t}{\sum_{t=1}^{N} (pre-tax\ income_t - special\ items_t)} \tag{8}$$

(Dyreng et al. (2008), p. 67)[10]

This enables them to (1) use and benefit from cash taxes paid in the numerator, without suffering from a potential mismatch of periods[11] (Dyreng et al. (2008), pp. 66–67), (2) measure corporate tax avoidance over a long period of time, reducing volatility present in annual ETR measures (Hanlon and Heitzman (2010), p. 141; Salihu et al. (2013), p. 417), and (3) reduce (though not eliminate) data truncation bias due to loss years (Henry and Sansing (2014), p. 4).

Although Long-Run Cash ETR solves many problems associated with annual ETR measures, it still suffers certain limitations: It is still limited to non-conforming tax avoidance, measures all influences on explicit tax liabilities and does not differentiate between aggressive and non-aggressive tax avoidance (Hanlon and Heitzman (2010), p. 141). Although reduced, there is still the risk of a truncation bias due to the elimination of loss firms (Henry and Sansing (2014), p. 4).

4.2. Henry and Sansing's HS Measure

Henry and Sansing (Henry and Sansing (2014), pp. 9–14) develop a measure (further referred to as HS) based

[8] This measure is used as a proxy for tax avoidance in Hope et al. (2013), or Lennox et al. (2013).

[9] The Cash ETR is, for instance, applied in studies from Chen et al. (2010), Dyreng et al. (2010) and Lennox et al. (2013).

[10] Long-Run Cash ETR has been widely used in tax research literature as a proxy for corporate tax avoidance as in Chen et al. (2010), Dyreng et al. (2010), Armstrong et al. (2012), Hope et al. (2013), Lennox et al. (2013), and Lisowsky (2010).

[11] Summing up cash taxes paid reduces the risk that a large portion of the numerator refers to a time period not captured in the denominator (Dyreng et al. (2008), p. 67).

on the Cash ETR which does not suffer a truncation bias.[12] They argue that the omission of loss firms leads to a substantial truncation bias for annual Cash ETR as well as for Long-Run Cash ETR.[13]

To avoid the omission of loss firms, they decompose the Cash ETR components. Cash taxes paid can be viewed as the combination of the expected amount of tax payments based on the pre-tax income times the statutory tax rate τ (the hypothetical case of a firm with no book-tax differences facing only one tax rate) and a combination of tax preferences, Δ. Those preferences explain the differences between the hypothetical case and the actual tax payments (Henry and Sansing (2014), p. 9):

$$cash\ taxes\ paid = \tau * (pre-tax\ income) + \Delta \quad (9)$$

This can be solved for Δ, yielding the tax preferences of a firm:

$$\Delta = cash\ taxes\ paid - \tau * (pre-tax\ income) \quad (10)$$

Henry and Sansing (2014) argue that pre-tax income equals size (Market Value of Assets, MVA) times accounting profitability (Return on Assets, ROA):

$$pre-tax\ income = MVA * ROA \quad (11)$$

In their view, using pre-tax income may lead to biased results, since ETR measures therefore are also driven by the pre-tax profitability (see decomposition of pre-tax income in eq. 10) and not solely due to differences in tax preferences. They propose to use Market Value of Assets (MVA) in the denominator to account for this problem, whereby MVA is defined as:

$$MVA = book\ value\ of\ assets + (markt\ value\ of\ equity - book\ value\ of\ equity) = BVA + (MVE - BVE) \quad (12)$$

(Henry and Sansing (2014), p. 10)

They measure corporate tax avoidance as the tax preferences, Δ, scaled by size (MVA):

$$HS = \frac{\Delta}{MVA} = \frac{cash\ taxes\ paid - \tau * (pre-tax\ income)}{MVA} \quad (13)$$

A firm without tax preferences ($\Delta = 0$, i.e. cash taxes paid = expected tax payment) will have a Cash ETR equal to the statutory rate and an HS of zero. If the tax preferences are positive ($\Delta > 0$, i.e. cash taxes paid > the expected tax payment), Cash ETR will be higher than the statutory rate and the HS will be positive. In the case of negative tax preferences ($\Delta < 0$, i.e. cash taxes paid < statutory tax rate), Cash ETR will be lower than the statutory tax rate and HS will be negative.

The HS measure solves two problems associated with ETR measures: First, it eliminates the risk of data truncation bias, because MVA will always be positive and no observations need to be dropped (Henry and Sansing (2014), p. 11). Furthermore, as already mentioned, HS is not driven by the pre-tax profitability of the firm (Henry and Sansing (2014), p. 10), which may distort ETR measures. Additionally, using MVA in the denominator should enable measuring conforming and non-conforming tax avoidance (Badertscher et al. (2015), p. 3). It is also possible to measure long-run tax avoidance using the HS measure (Henry and Sansing (2014), pp. 15–16). On the other hand, the HS measure lacks the intuitive interpretation of ETR measures, which makes interpretation more complicated (Bonsall et al. (2015, p. 13)).

4.3. Book-Tax-Differences Based Measures

The third approach uses differences between the financial income and taxable income, or Book-Tax-Differences (BTD). The BTD is usually defined as the difference between pre-tax income according to the financial statement (also called "book income") and the taxable income according to the tax return (Manzon Jr and Plesko (2002), p. 192; Guenther (2014), p. 7). Because of the confidentiality of tax return data, taxable income is estimated based on current tax expense as described above. This yields the basic formula for the Total BTD developed by Manzon Jr and Plesko (2002):

$$Total\ BTD = pre-tax\ income - \frac{current\ tax\ expense}{statutory\ tax\ rate} \quad (14)$$

(Manzon Jr and Plesko (2002), p. 192; Guenther (2014), p. 7)[14]

Prior research suggests that BTD are partly attributable to corporate tax avoidance. Desai (2003) argues that the increase in BTD during the 1990s is to some extent due to an increase in tax sheltering activity. Wilson (2009) also finds a significant effect of tax sheltering on BTD and so do Tang and Firth (2011). On the other hand, BTD are also associated with earnings management[15] (see Tang and Firth (2011) and Hanlon (2005)). Earnings management could influence the

[12] This relatively young measure finds application as a proxy of tax avoidance in papers by Bonsall et al. (2015), Cen et al. (2016) and Koester et al. (2016).

[13] For instance, Dyreng et al. (2008) drop 18 percent of the one year and 15 percent of the ten year observations in their study of "Long-Run Corporate Tax Avoidance".

[14] The Total BTD is used in papers by Wilson (2009), Chen et al. (2010), Lisowsky (2010), Lennox et al. (2013), and Desai and Dharmapala (2009a).

[15] Earnings management refers to actions managers take using their own judgement in financial reporting to influence financial outcomes (Healy and Wahlen (1999), p. 368) and thus may have an influence on BTD.

BTD in cases when managers try to inflate financial earnings, which would all else equal lead to an increase in the BTD. Therefore, measures based on Total BTD have been developed to account for the influence of earnings management.

4.3.1. Discretionary Total BTD

Based on the basic formula of the Total BTD developed by Manzon Jr and Plesko (2002), Desai and Dharmapala (Desai (2003), pp. 158–160) create a measure of corporate tax avoidance called Discretionary Total BTD (Lee et al. (2015), p. 27) or Abnormal BTD (Hanlon and Heitzman (2010), p. 141). To avoid BTD being driven by earnings management, they regress the Total BTD (eq. 13) scaled by lagged total assets[16] on total accruals (scaled by lagged total assets) which they argue reflect earnings management attempts:

$$\frac{BTD_t}{lagged\ total\ assets_t} = \beta_0 + \beta_1 * \frac{TA_t}{lagged\ total\ assets_t} + \epsilon_t \tag{15}$$

(Desai and Dharmapala (2006), p. 159)[17]

The residual $\epsilon_t + \beta_0$ is interpreted as the portion of BTD not associated with earnings management and, thus, can be used as a proxy for tax avoidance in year θ:

$$Discretionary\ Total\ BTD_t = \epsilon_t + \beta_0 \tag{16}$$

(Desai and Dharmapala (2006), p. 159)

Although Discretionary Total BTD controls for earnings management it might be biased due to the estimation of taxable income as discussed in Section 3. However, Desai and Dharmapala argue that at least the problem associated with nonqualified employee stock options will not impact their measure (2006, pp. 158–159). Because the measure consists of residuals, it sums up to zero over all firms and years and therefore can neither be interpreted as a dollar amount nor can it be used to calculate economy wide tax avoidance over all firms (Desai and Dharmapala (2006), p. 160). This also aggravates the interpretation of the Discretionary Total BTD, since it cannot be interpreted as easily as the ETR based measures. Per definition, Discretionary Total BTD is limited to non-conforming tax avoidance (Hanlon and Heitzman (2010), p. 141). Additionally, the Discretionary Total BTD does also not distinguish between actions that intentionally create Book-Tax-Differences and actions that accidentally create such differences (except for earnings management) (Frank et al. (2009), p. 472).

4.3.2. Discretionary Permanent BTD

To address the problem of Book-Tax-Differences not associated with tax planning, Frank et al. (Frank et al. (2009), pp. 472–474) develop their own measure, called Discretionary Permanent BTD. The measure only captures permanent Book-Tax-Differences following the argument that ideal tax shelter activities result in permanent differences between financial and taxable income and temporary BTD are also influenced by earnings management. They use Total Permanent BTD, defined as:

$$Total\ Permanent\ BTD = Total\ BTD - \frac{deferred\ tax\ expense}{statutory\ tax\ rate} \tag{17}$$

(Frank et al. (2009), p. 473)

The Total Permanent BTD can also be computed using an ETR differential, i.e. the difference between statutory tax rate and GAAP ETR multiplied by pre-tax income (Lee et al. (2015), p. 27).

This Total Permanent BTD is regressed on a set of control variables, which are known to create permanent Book-Tax-Differences but are not associated with tax planning, in order to make their measure robust against "accidental" BTD. Their measure is as follows:

$$Total\ Permanent\ BTD_t = \beta X + \epsilon_t \tag{18}$$

(Frank et al. (2009), p. 473)

Where X is a $m \times n$ matrix of control variables (with m observations for each firm and n control variables)[18], and β is the corresponding $1 \times n$ vector of coefficients. The error term ϵ_t is the Discretionary Permanent BTD (or DTAX); i.e. the portion of Total Permanent BTD that is driven by tax planning activities:

$$Discretionary\ Permanent\ BTD_t = DTAX_t = \epsilon_t \tag{19}$$

(Frank et al. (2009), p. 473)[19]

By construction, the Discretionary Permanent BTD excludes Temporary BTD, which has led to criticism by Hanlon and Heitzman (Hanlon and Heitzman (2010), p. 142). They argue that tax avoidance creates Permanent and Temporary BTD and thus the measure developed by Frank et al. (2009) may fail to measure a significant proportion of tax avoidance (such as tax deferral strategies). On the other hand, Frank et al. (Frank et al. (2009), p. 472) reason that the benefits

[16] The BTD is scaled by lagged total assets in order to control for firm scale (Desai and Dharmapala (2006), p. 158; Desai and Dharmapala (2009a), p. 540)), because the same BTD might be high for a relatively small firm and small for a relatively large firm (Guenther (2014), p. 7). This scaling makes BTD comparable between firms. They use the Ordinary Least Squares Method (OLS) for their regression.

[17] This measure is used for instance in studies from Desai and Dharmapala (2009b), and Chen et al. (2010).

[18] The control variables are: goodwill and other intangibles, income (loss) reported under the equity method, income (loss) attributable to minority interest, current state income tax expense, change in net operating loss carry forwards, and one-year lagged Total Permanent BTD (Frank et al. (2009), p. 473)

[19] The Discretionary Permanent BTD is, for instance, used in studies from, Lisowsky (2010), Tang and Firth (2011), and Lennox et al. (2013).

of excluding temporary differences is worth the costs of not measuring temporary tax avoidance. In their view, controlling for earnings management justifies this limitation. However, one could argue that it depends on the research question and targets to decide about the usefulness of the Discretionary Permanent BTD. Similarly to the Total BTD and Discretionary Total BTD, the Discretionary Permanent BTD only captures non-conforming tax avoidance (Hanlon and Heitzman (2010), p. 142).

4.4. Tax Shelter Scores

Besides ETR and BTD based measures, there have been attempts to measure the likelihood of tax shelter activities (considered to be one of the most aggressive form of tax avoidance; Lisowsky et al. (2013), pp. 590–591; Hanlon and Heitzman (2010), p. 137) based on certain firm characteristics.

Based on a sample of firms being accused of tax sheltering, Wilson (Wilson (2009), pp. 979– 984) uses a logistic regression model to regress the probability that a firm is identified as being engaged in tax sheltering (defined as $ln(\frac{P_{Shelter}}{1-P_{Shelter}})$) on certain firm

$$ln(\frac{P_{Shelter}}{1-P_{Shelter}}) = \beta X + \epsilon_t \quad (20)$$

(Wilson (2009), p. 982)

Where X is the $m \times n$ matrix of firm characteristics (with m observations and n control variables)[20] and β the corresponding $1 \times n$ vector of coefficients. He finds that BTD (Total, Permanent, and Temporary), leverage, and discretionary accruals (measure of earnings management) are significantly associated with tax sheltering. For instance, a one percent increase in Total BTD results in a 2.78 percent increase in the probability of tax sheltering and a one percent increase in discretionary accruals results in a 3.45 percent increase in the probability of tax sheltering (Wilson (2009), p. 986).

Lisowsky (2010) extends the framework of Wilson (2009) using a larger sample of firms and more firm characteristics.[21] Overall, his model has a 88 percent chance of identifying a tax shelter firm as one with a higher predicted probability of tax shelter likelihood (Lisowsky (2010), p. 1718).

Using the results of Wilson (2009) or Lisowsky (2010) one could estimate the likelihood of tax sheltering for the firm of interest and thus create a proxy for tax avoidance. While this approach may be a useful approximation for tax avoidance behavior, the results should be used with caution. Because the sample of firms used only contains firms being accused of tax sheltering it may not be possible to generalize those results for the whole population of firms. Corporations usually use many different practices to reduce their tax burden and only firms that either have already exploited all other techniques or are not able to exploit other techniques would rely on tax shelters. Thus the sample is likely to reflect only extreme cases of tax avoidance (Lee et al. (2015), pp. 29–30; Hanlon and Heitzman (2010), pp. 143–144). Furthermore, firms may be able to engage in tax sheltering without getting caught by the tax authorities. These firms, however, are not included in the sample (Lee et al. (2015), p. 30), making the generalization of the results questionable.

4.5. Unrecognized Tax Benefits

Another way to get a proxy for corporate tax avoidance is the usage of Unrecognized Tax Benefits reported in financial statements.[22] For fiscal years after December 15, 2006 all publicly traded U.S. firms are required to disclose so-called "Unrecognized Tax Benefits" in their financial statements according to Financial Accounting Standards Board Interpretation No. 48 (FIN 48) (Financial Accounting Standards Board (FASB) (2006), p. 7). Under this FIN 48 environment, there is a two-step process of evaluating uncertain tax positions (see Financial Accounting Standards Board (FASB) (2006), pp. 1–7). First, a firm recognizes all tax positions for which it is more likely than not (i.e. with a probability $>$ 50 percent) that the tax authorities will challenge those positions. Second, the identified tax positions should be valued at “the largest amount of tax benefit that is greater than 50 percent likely of being realized upon ultimate settlement with a taxing authority that has full knowledge of all relevant information” (Financial Accounting Standards Board (FASB) (2006), p. 3). As a result of this two- step process, there may be differences between the benefit recognized in the financial statement and the tax return. These differences are labeled Unrecognized Tax Benefits (UTB) and they are reflected by a contingent liability in the financial statements.

The rationale behind the argument that these UTB reflect corporate tax avoidance is that firms which are taking a more tax aggressive approach will have higher uncertainty in their tax positions and thus higher UTB compared to firms taking a more conservative approach (Lisowsky et al. (2013), p. 590). Therefore one can infer the degree of tax avoidance a firm is involved in from the UTB. To make the UTB comparable across firms it can be scaled by total assets (Lisowsky et al. (2013), p. 599).

Lisowsky et al. (2013) find a significant, positive relationship between tax shelter use and UTB. They also show that the results of Lisowsky (2010) (see Section 4.4) improve in quality when UTB is included. Furthermore, they find that the relationship between UTB and tax avoidance is not driven by earnings management, which could present a

[20] The firm characteristics used by Wilson (Wilson (2009), pp. 982–986) are Total BTD, Temporary BTD (defined as deferred tax expense grossed up by statutory tax rate), Permanent BTD (defined as Total BTD minus Temporary BTD), discretionary accruals, log of total assets, leverage ratio, foreign income, research and development scaled by total assets, and return on assets. These characteristics are associated with increased opportunities for tax sheltering.

[21] The variables involve those used in Wilson (2009) and add several new variables. For descriptions of those variables, see Lisowsky (Lisowsky (2010), p. 1704).

[22] Unrecognized tax benefits are discussed in studies from Lisowsky et al. (2013), Waegenaere et al. (2015), and Lee et al. (2015).

severe shortcoming of UTB as argued in Hanlon & Heitzman (Hanlon and Heitzman (2010), p. 143).

5. Empirical Analysis of Corporate Tax Avoidance Measures

The previously discussed measures of corporate tax avoidance are based on similar inputs. The variations of ETR and BTD measures especially are quite similar in computation. This leads to the question: How closely related are these measures among one another in measuring tax avoidance?

This question has already been discussed by other researchers. Lisowsky et al. (Lisowsky et al. (2013), pp. 589–592) argue that different measures capture different degrees of the "continuum" tax avoidance (see Section 2). They place measures such as GAAP ETR and Cash ETR on the less aggressive side of the continuum, and Total BTD, Discretionary Total BTD, Discretionary Permanent BTD and UBT on the more aggressive end of the range. Hanlon & Heitzman on the other hand find BTD based measures to be "closely related" (2010, p. 141) to ETR measures. Guenther (2014) goes even so far as to claim that BTD do not contain any different information compared to ETR measures besides adding measurement error. He shows that BTD (and also the HS) measures are basically just transformations of ETR measures.

To get a better understanding of the relationship between the different measures they will be compared empirically. In a first step the distributional characteristics and development of annual measures over time are analyzed (for the time period of 1996-2015) in order to examine if there are differences and similarities. Second, it will be investigated how good annual measures are at predicting long-term tax avoidance (for the time period of 2006-2015).

In the following, the focus will be on ETR, BTD, and the HS measures of tax avoidance because necessary information for computing tax shelter scores are not publicly available. Further, since UTB are only available for fiscal years after December 15, 2006, but the observation period will be from 1996-2015, UTB will not be part of the investigation because for a substantial part of the observations no UTB data will be available.

5.1. Sample Selection

The data retrieved covers all the available publicly traded companies from the Compustat Database for the years 1996 to 2015 for the first analysis and 2006-2015 for the comparison of annual and long-run measures. Reducing the observation period for the long-run comparison is necessary to maximize the sample since the fraction of firms having non-missing data for more than ten consecutive years is very small. For the first analysis, however, it is not important to have data over such a long time horizon without missing values. Thus, in order to maximize the sample, the observation period will cover twenty years of data.

The data items retrieved from the Compustat Database are summarized in Appendix 1. Requirements for the data in the first sample (Sample 1) are that there is no missing data for the items "total assets" (# 6 AT)[23], "total liabilities" (# 181 LT), "market value of equity" (# - MKVALT), "pre-tax income" (# 170 PI), "operating cash flow" (# 308 OANCF), "total tax expense" (# 16 TXT), "current tax expense" (# - TXC), "deferred tax expense" (# 50 TXDI), "cash taxes paid" (# 317 TXPD), or "net income" (# 172 NI). These restrictions are necessary to ensure that it is technically possible to compute the different measures of tax avoidance. In order to avoid the problem of firms facing several different tax rates which creates problems when estimating taxable income, only firms without foreign income are included in the sample (following Dyreng et al. (2008), p. 67). Further, certain items used for the computation of BTD are set equal to zero if they are missing. These items are "intangible assets – total" (# 33 INTAN), "Income (loss) reported under the equity method" (# 55 ESUB), "minority interest" (# 49 MII), "income taxes state" (# 173 TXS), and "tax loss carry forward" (# 52 TLCF). This is done based on the assumption that missing values in these categories indicate that they were zero for the observation period. Total accruals needed for the Discretionary Total BTD are calculated by subtracting "operating cash flow" from "net income" (# 172 NI) (Penman (2013), p. 123, 125), and are set equal to zero if missing.

For the second analysis (Sample 2), firms are additionally required to have ten years of non-missing data for the years 2006 to 2015. The five-year measures are computed for the time period 2006 – 2010 and 2011 – 2015, the ten-year measures for the time period 2006 – 2015.

The ETR measures are computed according to the formulas above. Because negative ETRs are difficult to interpret they are excluded from the analysis if either the numerator is negative or the denominator is less or equal to zero. Further, ETR measures above one and below zero are excluded to improve interpretation.

The HS measure is calculated according to the formulas above. In order to control for outliers the smallest and biggest percentage of observations is excluded from the analysis.[24]

The BTD measures are regressed with two modifications. The Total BTD is scaled by the one year lagged value of total assets in order to make the measure comparable across firms (following Desai and Dharmapala (2009a), p. 540; Lisowsky (2010), p. 1704). For the computation of the Discretionary Permanent BTD all variables are scaled by the one-year lagged value of total assets in order to achieve the same goal. Values for BTD are computed unless a firm has only data existing for one year, which makes a linear regression

[23] The brackets display the Legacy CST Item Number (retrieved from the Center for Research in Security Prices (2016)) and the mnemonic abbreviation of the Compustat Database (retrieved from Wharton Research Data Services (2016a)) of the data items.

[24] For the effects outliers might have on the results see Toutenburg, Heumann, and Schomaker (Toutenburg et al. (2009), p. 187); Wooldridge (Wooldridge (2013), pp. 316–324).

Table 1: Distributional Characteristics of Annual Measures

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
GAAP ETR	20,003	0.3009	0.1582	0	0.9989
Current ETR	19,793	0.2365	0.1874	0	1
Cash ETR	19,848	0.2124	0.1900	0	1
CFM1	20,400	0.2358	0.2117	0	1
CFM2	22,597	0.1682	0.2021	0	1
HS	36,018	0.0281	0.0677	-0.0630	0.4994
Total BTD	19,795	0.0324	0.0849	-0.1332	0.8587
Discretionary Total BTD	18,079	0.0232	0.0657	-0.1937	0.4227
Discretionary Permanent BTD	19,223	0.0071	0.0439	-0.1358	0.4445

impossible. Loss years are omitted from the sample (i.e. in cases where pre-tax income or current tax expense < 0) since the BTD is likely to be erroneous because the estimation of taxable income is likely to result in meaningless results. To control for outliers the smallest and biggest percentage of observations is excluded from further analysis.

At this point it should be mentioned that these data requirements can lead to biased results, since a substantial fraction of observations is omitted. However, the requirements are necessary in order to be able to compute the measures and interpret them properly. A summary of the impact of the data requirements is given in Appendix 2. Overall, only approximately 50 percent of the observations are usable for ETR and BTD measures in the first sample. In contrast, the HS measure enables the use of 91.40 percent of the observations (in Sample 1). As already described, this is due to the use of MVA as the numerator instead of pre-tax income, which is always positive (see Section 4.2 for a detailed argumentation).

Also note that the high fraction of used observations for Discretionary Total BTD (0.9801) is only due to the fact that this kind of BTD can solely be computed if the Total BTD is available. Therefore a substantial amount of observations is already lost due to technical reasons (i.e. all observations for which Total BTD is not usable; this includes all observations with pre-tax income or current tax expense below zero). Interestingly, the fraction of usable observations is higher for the second sample. On the other hand, increasing the observation period from one to up to ten years (for long-run measures) reduces the possible truncation bias just slightly.

5.2. Comparison of Annual Measures

In a first step of the analysis the annual measures are compared to show differences and similarities between them for the observation period and over time.

5.2.1. Distributional Characteristics

Table 1 gives an overview of the main summary statistics of the measures.[25]

[25] Those are the arithmetic mean (Mean), standard deviation (Std. Dev.) and the minimal (Min.) and maximal (Max.) values. Please note that the values in all tables are rounded to four decimal places.

The data reveals that the GAAP ETR has the highest mean of all ETR based measures (0.3009) followed by Current ETR (0.2365), CFM_1 (0.2358), Cash ETR (0.2124), and CFM_2 (0.1682). GAAP ETR, having the highest mean, is consistent with the theoretical argumentation that it only captures non-conforming tax avoidance and ignores tax deferral strategies. Therefore, it is consistent for Current ETR to be lower since it reflects tax deferral strategies. One could argue that Cash ETR should lie below Current ETR because cash taxes paid is not subject to overstatement to the same extent as current tax expense is. This argument is supported by Cash ETR having a lower mean than Current ETR. Finally CFM_2, having the lowest mean, is in line with it being the only measure also capturing conforming tax avoidance. The interpretation of CFM_1 is in some way hard, since it should be less but still vulnerable to accrual accounting making an interpretation of the result difficult. The mean of HS is close to zero because of the differing interpretation of the measure. Because of this it does not make sense to compare the mean of HS with ETR or BTD measures. Surprisingly, the positive value of 0.0281 indicates that firms have, on average, positive tax preferences. The mean of all BTD measures is slightly above zero, which implies that on average the BTD is positive and thus the taxable income is below the book income. The results support the view that the Total BTD may be influenced also by other factors than tax planning (i.e. it has the highest mean of all BTD, 0.0324). The Discretionary Total BTD is lower (0.0232) which is in line with excluding earnings management as a driver of large BTD. Finally, the Discretionary Permanent BTD controls for more drivers of BTD not associated with tax planning and thus yields the lowest average of BTD measures (0.0071).

Looking at the standard deviation (Std. Dev.) of ETR measures one can infer that all measures using either cash taxes paid in the numerator and/or operating cash flow in the denominator have a higher variability than those using pre-tax income or total tax expense. This result is not surprising since accrual accounting (evident in pre-tax income and total tax expense) smoothens fluctuation in cash flows over the years (Dechow (1994), p. 19). Cash taxes paid and operating cash flow on the other hand should be subject to a higher volatility. The volatility of BTD decreases from To-

tal to Discretionary Total BTD and is lowest for Discretionary Permanent BTD.

Graphically, the distributions of ETR and HS measures are shown in Figure 1. Notably, the measures are distributed around their means. Further there is a relatively high fraction of ETR observations in the range [0, 0.1]. This is due to the fact that for these observations the numerator often takes very small values. It also becomes evident that higher values of ETR (values in the range (0.5, 1]) are relatively rare. Not surprisingly, the HS measure is centered on zero, which is in line with the interpretation of the measure and the mean close to zero (0.0281). The distribution also reveals that although the mean is positive, a large fraction of HS is slightly negative, suggesting that a substantial fraction of observations is identified as having negative tax preferences. The distributions of BTD measures in Figure 2 reveal that those measures are centered on zero. Total BTD and Discretionary Total BTD have quite similar distributional patterns with slightly positive BTD. In line with a mean of 0.0071 and a small standard deviation of 0.0439, the Discretionary Permanent BTD is clustered closely around zero. Overall, the distributions of the single measures exhibit considerable variation.

All in all, the comparison of means, standard deviations, and distributions has shown that there are differences between annual measures. Additionally, possible explanations for those differences have been given. However, it cannot be ruled out, that those differences are due to sampling error.

5.2.2. Development of Measures over Time

To examine whether the means of the annual measures face changes over time, Figure 3 and 4 display the means of those over the time horizon 1996-2015. In the figures it becomes evident that on average the ETR decreased over time while the HS and BTD measures increased. These findings are in line with prior research. Graham and Tucker (Graham and Tucker (2006), pp. 564–565) find a decrease in Effective Tax Rates for S&P 500 firms over the period of 1988-2004 and reports a similar pattern for all publicly traded firms, while Desai (2003) finds an increase in BTD during the 1990s. A decrease in ETR corresponding with a simultaneous increase in BTD suggests, that both measures could capture an increase in tax avoidance (as argued in Desai (2003), p. 170 for BTD).

It becomes evident, that the differences between the means as described above are constant over time. The order of the means (from highest to lowest) remains the same for the ETR measures (except for CFM_1) and BTD. This supports the argumentation that there are differences between the measures. However, all measures seem to follow the same pattern over time, which suggests, that despite their differences they might capture, at least to some point, similar aspects of tax avoidance (alternatively the measures might be driven by other economy wide powers).

5.2.3. Correlation between Annual Measures

Although summary statistics and frequency distributions give a first insight about the properties and similarities of the different measures, it is interesting to investigate how closely related the measures are, given that despite differences in means, they seem to behave in some way similarly over time. This can be examined using a correlation matrix. The correlation matrix is based on the Bravais-Pearson correlation coefficient, which can be used for metric data such as the data at hand. The Bravais-Pearson correlation coefficient yields values from -1 to 1, where -1 indicates a perfect negative linear relationship and 1 a perfect positive linear relationship; 0 represents no linear relationship (Toutenburg et al. (2009), pp. 130–137). The correlation matrix of the annual measures is displayed in Table 2.

The correlation matrix shows that there is a high positive linear relationship between ETR measures ranging from 0.3953 between GAAP ETR and CFM_2 to 0.7789 between CFM_1 and CFM_2. This is not surprising since the measures are based on the same rationale and use similar inputs. Also not surprising is that measures with the same inputs in the numerator or denominator such as CFM_1 and CFM_2 (both using operating cash flow) or Cash and Current ETR (both using pre-tax income) seem to be more highly correlated. The correlation between ETR measures and the HS measure is also positive, yet lower. This may be due to the different interpretations of the measures. As one would expect, the correlation coefficients between ETR and BTD are negative, suggesting that a low ETR is associated with positive BTD. However, the correlation decreases when ETR measures are compared with Discretionary Total BTD or Discretionary Permanent BTD. The BTD measures are positively correlated among one another (ranging from 0.1343 to 0.6507), which should be due to the similarities of computation.

Overall, the correlation analysis suggests that ETR measures behave quite similarly. Also ETR and BTD are correlated, meaning that those measures should measure similar aspects of tax avoidance. BTD measures (especially Discretionary Total and Permanent BTD) face a weaker correlation among themselves, suggesting that those measures might be able to proxy different aspects of tax avoidance. However, since this analysis is only descriptive in nature, one cannot rule out the possibility that those relationships are sample-specific.

5.3. Comparison of Annual and Long-Run Measures

In a second step, several measures of long-run tax avoidance (spanning time periods of five to ten years) are compared with one another. These measures are then compared to annual measures in order to investigate how closely related annual and long-run measures are and how good the former are in predicting long-run tax aggressiveness.

5.3.1. Distributional Characteristics of Long-Run Measures

Looking at the means in Table 3 (and Table 1), Long-Run Cash ETR seems to increase as the observation period

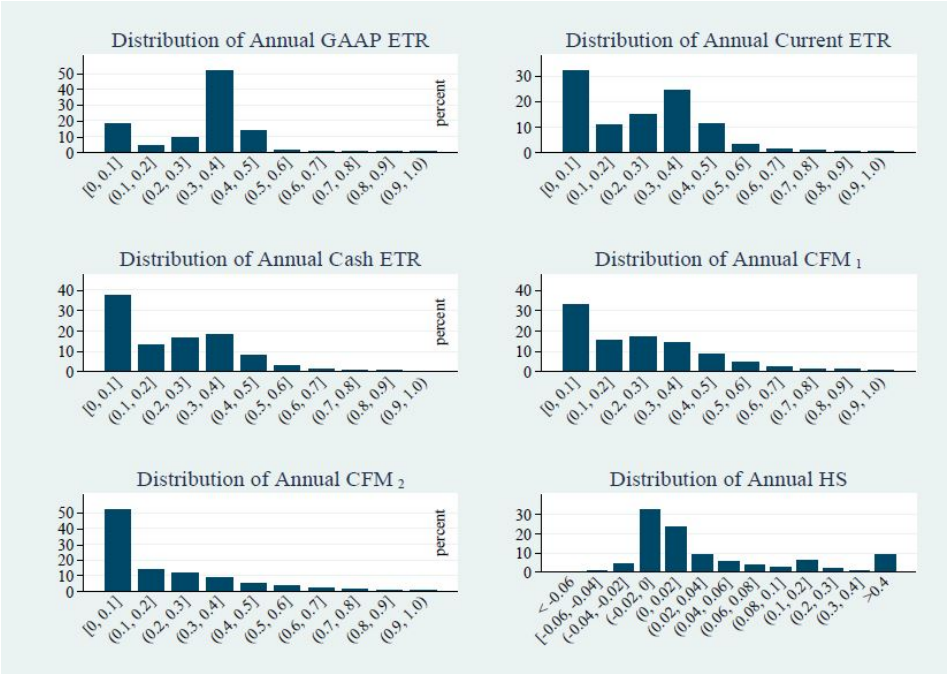

Figure 1: Distribution of Annual ETR and HS

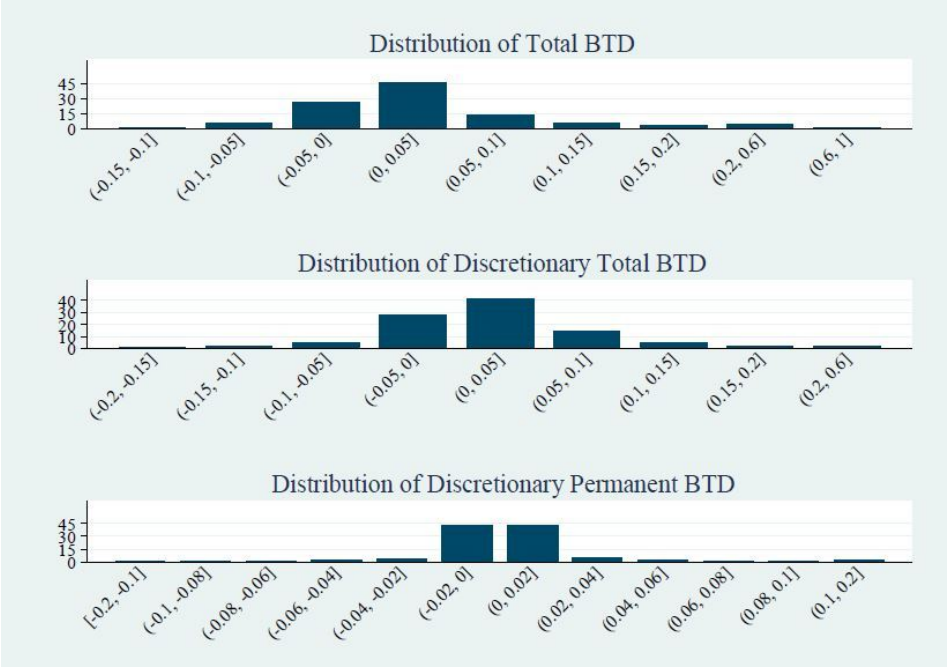

Figure 2: Distribution of BTD

increases (from annual to ten years 0.2124, 0.2415, 0.2456, respectively). This suggests that it becomes more difficult for firms to maintain a low Cash ETR over time. Conversely, the HS measure decreases as the observation period increases (from annual to ten years 0.0281, 0.0048, 0.0042, respectively). So, according to the HS measure, tax preferences decrease over time, meaning that the actual tax payments converge to the hypothetical tax payments. Taken together, both long-run measures seem to converge to a lower degree of tax avoidance as the observation period increases, suggesting that it is difficult to maintain tax benefits over long periods of time.

The standard deviation reveals, that the variation of the measures decreases as the observation period increases (from annual to ten years 0.1900, 0.1518, 0.1450, respectively, for Cash ETR, and 0.0677, 0.0195, 0.0167, respectively, for HS),

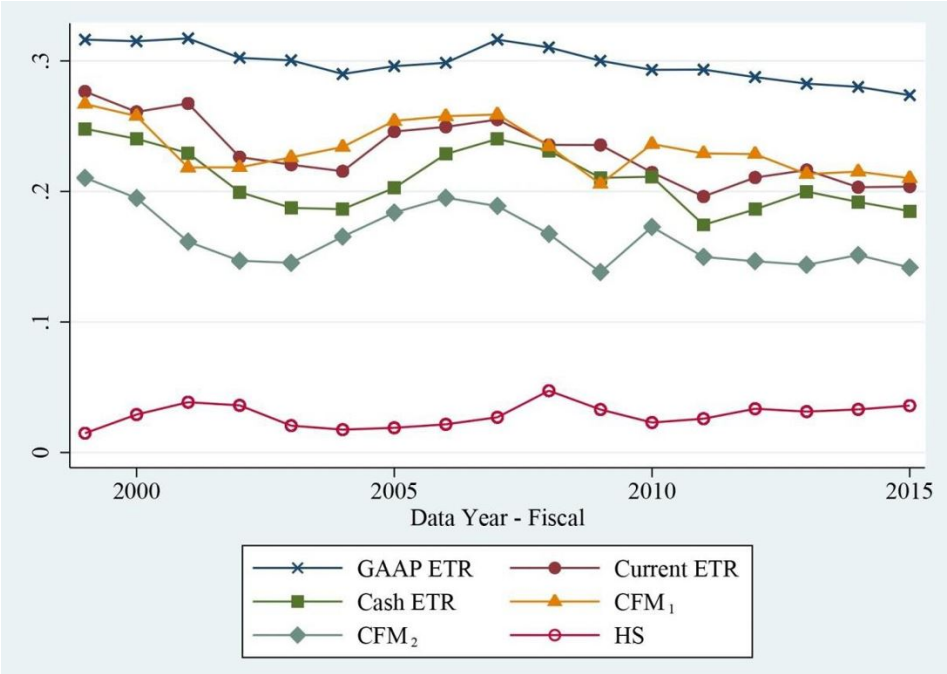

Figure 3: Development of ETR and HS Measures over Time

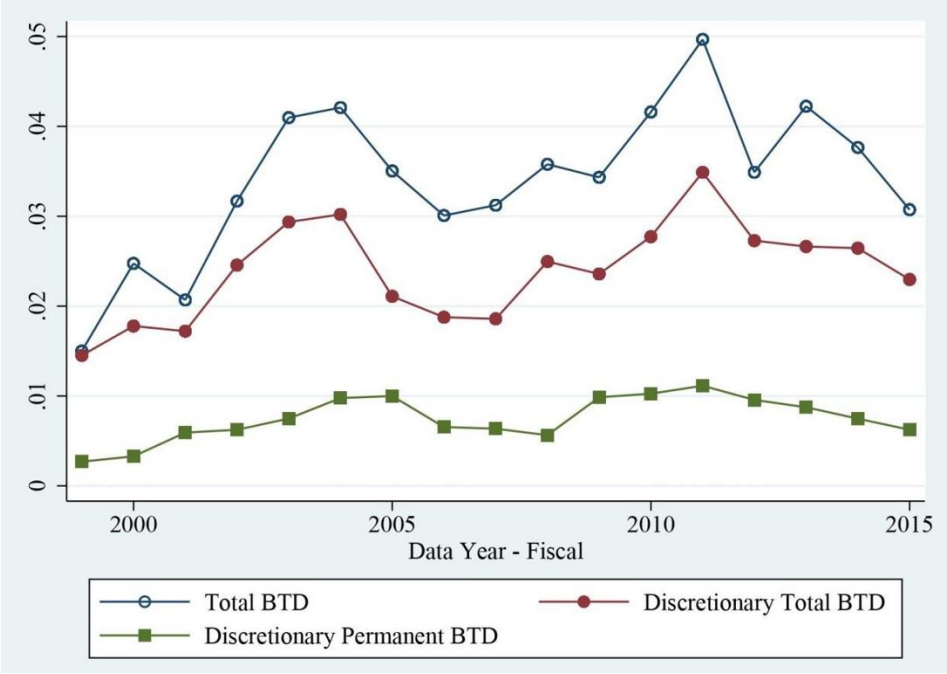

Figure 4: Development of BTD Measures over Time

which is in line with the theoretical argumentation.

Similarly, the distributions depicted in Figure 5 (and Figure 1) show that over time, the distributions tighten as the observation period increases. For Cash ETR, the fractions of observations close to zero and one decrease while more observations fall into the range of (0.3, 0.4] (near the statutory tax rate of 0.35). The HS measure gets clustered even closer around zero.

5.3.2. Correlation between Annual and Long-Run Measures

To compare annual and long-run measures, the Bravais-Pearson correlation coefficients are displayed in Table 4.

The correlation coefficients between annual ETR and long-run measures of tax avoidance are positive. This positive correlation with long-run measures is strongest for Current and Cash ETR (between 0.5147 and 0.6664 for Current ETR and between 0.4962 and 0.6793 for Cash ETR), The cor-

Table 2: Correlation Matrix of Annual Measures

	GAAP ETR	Current ETR	Cash ETR	CFM_1	CFM_2	HS	Total BTD	Discr. Total BTD	Discr. Permanent BTD
GAAP ETR	1.0000								
Current ETR	0.5857	1.0000							
Cash ETR	0.5135	0.7306	1.0000						
CFM_1	0.5830	0.4482	0.4015	1.0000					
CFM_2	0.3953	0.5636	0.7301	0.7789	1.0000				
HS	0.3298	0.5216	0.7410	0.2169	0.5628	1.0000			
Total BTD	-0.3619	-0.6386	-0.4946	-0.2493	-0.3899	-0.5971	1.0000		
Discr. Total BTD	-0.3343	-0.5069	-0.4037	-0.2399	-0.3385	-0.4545	0.6507	1.0000	
Discr. Permanent BTD	-0.1845	-0.1094	-0.0836	-0.1213	-0.0718	-0.0800	0.1505	0.1343	1.0000

Table 3: Distributional Characteristics of Long-Run Measures

Variable	Obs.	Mean	Std. Dev.	Min	Max
lr. Cash ETR_5	682	0.2415	0.1518	0	0.9348
lr. Cash ETR_{10}	354	0.2456	0.1450	0	0.8357
lr. HS5	911	0.0048	0.0195	-0.0262	0.1099
lr. HS_{10}	470	0.0042	0.0167	-0.0275	0.0997

Table 4: Correlation between Annual and Long-Run Measures

	lr. Cash ETR_5	lr. Cash ETR_{10}	lr. HS5	lr. HS_{10}
GAAP ETR	0.3809	0.4051	0.3244	0.3397
Current ETR	0.6664	0.6243	0.5544	0.5147
Cash ETR	0.6793	0.6030	0.5751	0.4962
CFM1	0.4205	0.4559	0.3200	0.3507
CFM2	0.5793	0.5503	0.4859	0.4434
HS	0.5229	0.4467	0.5691	0.4629
Total BTD	-0.4786	-0.4435	-0.5165	-0.4554
Discr. Total BTD	-0.3696	-0.3374	-0.3859	-0.3271
Discr. Permanent BTD	0.0370	0.0324	0.0490	0.0380
Lr Cash ETR_5	1.0000			
Lr. Cash ETR_{10}	0.8448	1.0000		
Lr. HS5	0.8019	0.6894	1.0000	
Lr. HS_{10}	0.6776	0.8051	0.7765	1.0000

relation of CFM_2 ranges between 0.4434 and 0.5793 while those of GAAP ETR and CFM_1 are lower, yet still positive. The correlation is stronger between annual and long-run ETR measures than between annual ETR and long-run HS. Also, Annual HS is positively correlated with the long-run measures while the correlation between annual and long-run measures of the same kind is higher than across measures. It appears plausible that the correlation between annual and long-run measures increases with higher similarity in inputs and computation. For all ETR measures except GAAP ETR and CFM_1 the correlation with the five-year measures is higher than with the ten-year measures. Similarly, the correlation between Annual HS and the long-run measures decreases over time.

The Total and Discretionary Total BTD are negatively correlated to the proxies for long-run tax avoidance. Notably, this negative correlation decreases as the observation period increases. Further, the correlation for Discretionary Total BTD (ranging from -0.3271 to -0.3696) is lower than for Total BTD (ranging from -0.4554 to -0.5165). Surprisingly, the Discretionary Permanent BTD is positively correlated with the long-run measures (ranging from 0.0324 to 0.0490). However, this correlation is close to zero suggesting no linear relationship. Overall, the BTD seem to be higher (negatively)

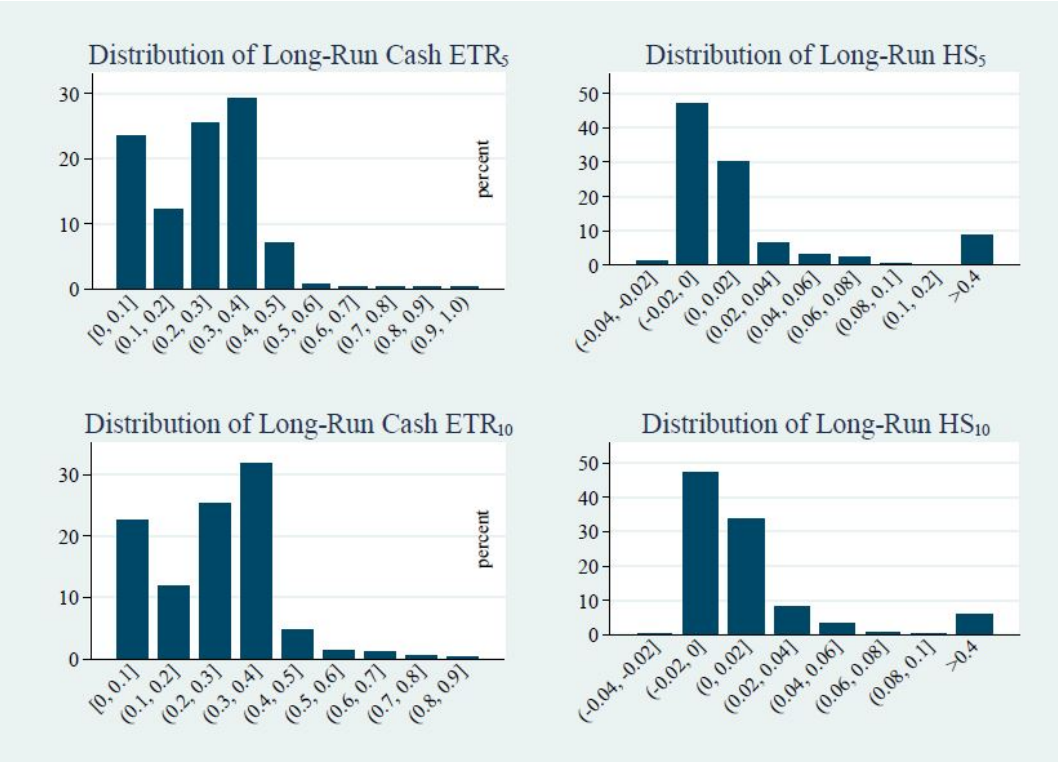

Figure 5: Distribution of Long-Run Measures

correlated with the Long-Run HS measure than with Long-Run Cash ETR. As one would expect, the correlations between the five- and ten-year measure of the same kind are very high (0.8448 between lr. Cash ETR_5 and lr. Cash ETR_{10} and 0.7765 between lr. HS5 and lr. HS_{10}). The correlation between Long-Run Cash ETR and Long-Run HS is high for both five- and ten-year measures. This suggests that both kinds of long-run measures will detect similar aspects of long-run tax avoidance.

Altogether, the correlation between most annual and long-run measures is relatively high. Not surprisingly, annual ETR (HS) measures are more highly correlated with long-run ETR (HS) measures. In most cases the correlation between BTD and Long-run HS is higher than between BTD and Long-Run Cash ETR. The correlation between long-run measures is very high.

5.3.3. Reliability of Annual Measures in Predicting Long-Run Tax Avoidance

Although the correlation coefficients show the relationship between the single measures, it does not become clear, how reliable annual measures can predict long-run tax aggressiveness. Therefore, an additional analysis is conducted. The proxies based on annual numbers and over time are sorted into two groups, "low" and "high" depending on the values they take. For ETR measures, an observation is allocated to the group "low" if the Effective Tax Rate is below 0.35 and "high" if the tax rate is above or equal to 0.35. BTD measures are classified as "low" if BTD > 0 and "high" if BTD ≤ 0. The HS measure is defined as "high" if HS > 0 and "low" if HS ≤ 0. Subsequently, the observations are counted for which both the annual and long-run measures either take "low" or "high" values, i.e. for which the annual measure correctly identifies the firm to pay a low (high) amount of corporate taxes according to the longrun measure; Table 5 column (A) displays the relative frequencies for which annual measures identify the long-run tax behavior correctly.

As one can see, the reliability of annual measures in predicting long-run tax avoidance is not very high. GAAP ETR is only able to identify 0.5854 of the observations correctly according to Long-Run Cash ETR. The fractions for CFM_1 and CFM_2 are slightly higher (0.6529, 0.6342 (0.6534, 0.6250) for Long-Run Cash ETR (HS), respectively). Only Current and Cash ETR exhibit a greater reliability with fractions of approximately 0.67 to 0.68 for both long-run measures. The Annual HS measure is able to identify 0.6822 of observations correctly according to the Long-Run Cash ETR. According to the Long-Run HS measure, the fraction of correctly identified observations increases to 0.6902. Total BTD are able to identify 0.4512 (0.4776) of observations correctly according to Long-Run Cash ETR_{10} (HS_{10}). This fraction increases for Discretionary Total BTD (0.4848, 0.5172 for Long-Run Cash ETR_{10} and Long-Run HS_{10}, respectively) and Discretionary Permanent BTD (0.5616, 0.5888, respectively). Interestingly, according the Long-Run HS_{10}, the reliability of annual measures is in most cases higher than the Long-Run Cash ETR_{10} suggests. When looking separately at the correct identification of "low tax paying firms" and "high tax paying firms" it

Table 5: Reliability of Annual Measures in Predicting Long-Run Tax Avoidance

		(A)		(B)	
		lr. Cash ETR_{10}	lr. HS_{10}	lr. Cash ETR_{10}	lr. HS_{10}
GAAP ETR	low	0.7303	0.6814	0.5214	0.6674
	high	0.5212	0.6150	0.7364	0.6366
	total	0.5854	0.6354	0.6610	0.6474
Current ETR	low	0.7545	0.6790	0.6288	0.6871
	high	0.6100	0.6937	0.7832	0.6384
	total	0.6758	0.6870	0.7318	0.6546
Cash ETR	low	0.7393	0.6648	0.6089	0.6756
	high	0.6229	0.7083	0.7750	0.6340
	total	0.6804	0.6868	0.7192	0.6480
CFM1	low	0.7094	0.6370	0.5399	0.6080
	high	0.5901	0.6716	0.7421	0.6013
	total	0.6529	0.6534	0.6732	0.6036
CFM2	low	0.6681	0.5893	0.5311	0.5610
	high	0.5901	0.6716	0.7458	0.5813
	total	0.6342	0.6250	0.6684	0.5740
HS	low	0.7456	0.6713	0.5345	0.6864
	high	0.6225	0.7080	0.7879	0.7000
	total	0.6822	0.6902	0.6764	0.6940
Total BTD	low	0.5166	0.3928	0.2264	0.4485
	high	0.4331	0.5010	0.5825	0.5193
	total	0.4512	0.4776	0.4642	0.4958
Discr. Total BTD	low	0.5851	0.4858	0.2928	0.4978
	high	0.4532	0.5271	0.6167	0.5433
	total	0.4848	0.5172	0.5118	0.5286
Discr. Permanent BTD	low	0.6844	0.6016	0.4112	0.5942
	high	0.5041	0.5828	0.6745	0.5918
	total	0.5616	0.5888	0.5870	0.5926

becomes clear that the persistence of "low tax paying firms" is higher looking at the Long-run Cash ETR_{10} measure, while the reverse is the case according to the Long-Run HS_{10} measure.

These results may be distorted by economy-wide shocks that could result in large losses for the firms on average in single years. Thus all or at least a majority of the firms would exhibit low tax payments in years around those shocks (due to loss carry backs and loss carry forwards) not associated with tax avoidance. In those years, comparing ETR with the statutory tax rate and HS and BTD with zero to decide about the degree of tax avoidance would lead to wrong inferences. To test whether the results in Table 5, column (A) are driven by such economy-wide shocks, column (B) compares the measures of a year with the corresponding median of all firms in that year.

As one can see, the overall reliability of annual measures in predicting long-run tax avoidance increases in most cases when medians instead of fixed values are used in allocating observations (this is true for both measures). Interestingly, the persistence of observations being identified as "low" decreases while the reverse is the case for "high" observations. Thus, using fixed values for allocation purposes may be misleading.

Overall, the reliability of annual measures in depicting long-run tax avoidance is not very high. Only looking at one year seems not to provide enough information to make solid conclusions about the tax aggressiveness across time since a substantial fraction of observations would be incorrectly classified as "high" or "low". Furthermore, the decisions about the tax aggressiveness solely made on fixed limits may be misleading in single years.

6. Conclusion

The aim of this bachelor thesis is to give an overview of and analyze the different measures of tax avoidance used in the literature and to answer the question of how closely related these measures are among one another. In the empirical tax research there are several proxies for tax avoidance, most of which rely on financial accounting data. Most prevalent are measures based on ETR and BTD. Besides these two, measures from Henry and Sansing (2014), Tax Shelter Scores, and the Unrecognized Tax Benefits are used to proxy for tax avoidance. All measures differ with respect to the underlying rationale of measuring tax avoidance and the inputs

used. This leads to the question of how closely related the measures are, which is tested empirically.

The descriptive results suggest that, although there are differences between the single measures and those differences persist over time, especially annual proxies exhibit considerable correlation. This correlation gets stronger as the similarity in computation and inputs increases and is strongest between measures of the same kind. The results suggest that the different measures may in fact be closely related. A comparison between annual and long-run measures implies that the reliability of annual measures in depicting long-run tax avoidance seems not sufficiently high. Since the samples used in the empirical investigation may be subject to a substantial truncation bias due to stringent assumptions, the results may only be sample-specific.

In conclusion it should be mentioned that the right choice for a measure of corporate tax avoidance heavily depends on the data availability and aims of the research question at hand. Since some measures require more inputs than others and may exclude/include specific forms of tax avoidance, which others do not, specific measures may be more suitable than others. Also a common approach of researchers if data availability is no issue is to use several different proxies simultaneously to investigate, how their results are influenced by the proxies for tax avoidance.

Besides the existing literature, the need for research about (measuring) corporate tax avoidance still remains. First, a universally accepted definition of tax avoidance is still missing, which prevents the creation of more powerful measures. Although one single sharp definition may be unrealistic, Hanlon and Heitzman (Hanlon and Heitzman (2010), p. 137) argue that continued research may increase the probability of an accepted definition. Second, since all existing measures exhibit limitations, the search for new forms of measuring tax avoidance should be continued. Third, further research should analyze the relationships between measures beyond purely descriptive statistics to be able to make universal statements. Among others, these are issues that need to be addressed in the future.

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