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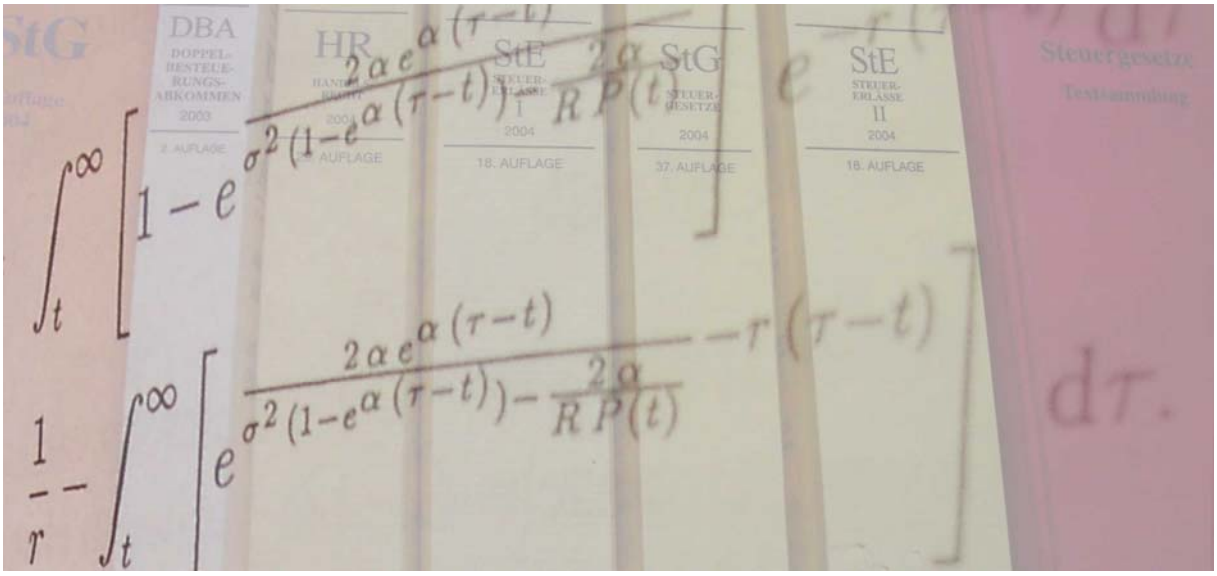


Diskussionsbeitrag Nr. 55

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Income-related Minimum Taxation Concepts and their Impact on Corporate Investment Decisions

Oktober 2008

**arqus** Diskussionsbeiträge zur Quantitativen Steuerlehre

**arqus** Discussion Papers on Quantitative Tax Research

ISSN 1861-8944

# Income-related Minimum Taxation Concepts and their Impact on Corporate Investment Decisions


## Abstract

In this paper we analyze the impact of various minimum taxation concepts on corporate investment decisions. These investments can be realized in the form of either a real or a financial investment. In a quantitative analysis we refer to the future values of the investments as an indicator of tax-favored and tax-discriminated projects. Varying the concept-specific loss-offset parameters and cash flow time structure and performing a Monte Carlo simulation reveals the impact of the particular minimum taxation concept. For the first time a comprehensive set of equations has been deduced to integrate different minimum tax concepts in a unique model. The resulting equations can be used as a basis for further analyses of group taxation, wealth taxation and asymmetric taxation and allows us to gain first insights into the direction and magnitude of tax distortions of possible competing concepts. Depending on the set of parameters, complex and ambiguous tax effects can be identified. The effect of minimum taxation depends on the existence and magnitude of a depreciation effect. Both effects run contrary to each other, and the depreciation effect is always greater. We find that all concepts distort in the same direction and that real investments with increasing cash flows are more likely to be discriminated by minimum taxation than financial investments or real investments with constant cash flows. However, in comparison to real investments with decreasing cash flows financial investments suffer more from income-related minimum taxation concepts. These results provide interesting information for corporate investors having to decide on the location of an investment, and for tax reform discussions.



**Keywords:** corporate taxation, investment, loss carry-forward, loss-offset, minimum taxation, Monte Carlo simulation

**JEL classification:** H25, H21, G31

# I INTRODUCTION

Since the European Court of Justice ruled in the Marks & Spencer case in December 2005, rules for the asymmetric treatment of gains and losses have attracted particular attention also in tax reform discussions and research. The related fields of minimum taxation, group taxation, consolidated tax bases for groups in Europe and loss offsets in cross-border working companies are also being debated.

For many years, and more recently in the Marks & Spencer context, minimum taxation has been an issue for international tax research as well as for political tax discussions in all major western countries. These concepts are a means to prevent undesired but legally permitted tax avoidance. Minimum taxation concepts promise to ensure that companies with substantial income cannot avoid paying taxes by taking advantage of loopholes and tax shelters. In view of the difficult and tight financial situation of the public sector in many countries, different concepts have already been implemented to enforce this and to ensure or at least stabilize tax revenue. Among these countries are e.g., Germany, Brazil, the Netherlands, Austria, Poland and the United States. General interest in minimum taxation concepts is on the increase now that various designs for minimum taxation are being implemented in different countries and are the subject of several tax reform discussions.

The basic literature distinguishes between three different kinds of minimum taxation: Minimum taxation as a form of
a) a loss offset limitation,
b) a fixed amount of taxes, and finally
c) a minimum tax rate or minimum collection rate.

Furthermore, one can categorize the concepts with respect to the tax object they are linked to. Thus minimum taxation can be linked to income (Germany, Austria, Brazil, Poland and USA) and to wealth. Further, the wealth tax is a widespread second-best tool to prevent tax evasion (e.g. Luxembourg, Switzerland, France, Spain and Norway). It rarely emerges as a form of minimum taxation. The Netherlands operates an example of such a non-profit oriented minimum (wealth) tax that goes by the name of "presumptive capital income tax".[1] As all these concepts are barely comparable, the focus of this paper is on income-related concepts.

In the literature there are several papers on the economic influence of specific minimum taxation concepts, particularly on the US concepts of alternative minimum taxation which was introduced in the 1960s. The results are ambiguous and in some cases even contradictory. Studies on American minimum taxation attest their distorting and under certain circumstances inhibiting impact on investment decisions (Schnee (2004), Dworin (1987)). Chorvat/Knoll (2003) point out that the American corporate alternative minimum tax (CAMT) hinders investment activities, affects the allocation of resources and increases compliance costs. So does Lyon (1997), who demonstrates that the AMT has not led to more efficiency and fairness. Lyon (1990) also develops a model of cost of capital for firms considering minimum taxation. He

[1] Cf. Wijnbergen, S./Estache, A. (1999), p. 76.

finds that cost of capital is sensitive to the duration, the timing and the source of the investment.

Feenberg/Poterba (2004) and Burman/Gale/Harris (2002) show that without taking account of inflation an increasing number of taxpayers are affected by the AMT. Furthermore, the postulate of a balancing taxation is violated (Burman/Gale/Rohaly (2003)). Bernheim (1989) analyzes the effects of the CAMT on investment planning and decisions in and between firms. He shows that the aim of the AMT under certain conditions is compatible with the minimization of tax distortions. Carlson (2001) shows that corporations with increasing income are rarely liable to the CAMT which runs contrary to the intention of taxing taxpayers with high income.

As minimum taxation is a form an asymmetric taxation it is important to refer to this stream of literature. Studies on the influence of asymmetric treatment of gains and losses highlight the effects on corporate behavior, e.g., how asymmetric taxation influences the marginal tax rates and hence financing and compensation decisions. In this context Eeckhoudt/Hansen (1982) and Eeckhoudt/Gollier/Schlesinger (1997) focus on the effect of asymmetric taxation on risk propensity. A subgroup of the asymmetric taxation literature deals with the impact of limited loss offset on the cost of capital and on investment incentives (Auerbach (1986), Majd/Myers (1986), Auerbach/Poterba (1987), Lyon (1990)). Auerbach (1986) demonstrates how the timing of taxes and company characteristics in the form of high or low fixed costs can influence company behavior when gains and losses are treated asymmetrically. Whereas a loss-offset limitation discourages investment, he shows that in case of high fixed costs a move towards complete loss-offset seems more likely to increase distortions than to decrease them. Auerbach/Poterba (1987) study the magnitude of the aggregated loss carry-forwards by using data taken from the annual reports of large corporations. They find that the loss carry-forward status is rather persistent and that 15% of all firms report loss carry-forwards. Barlev/Levy (1975) analyze the impact of loss carry-forwards and carry-backs on investment and financing decisions by featuring the present value of the tax savings of various countries. They show that utilized carry-backs would improve the economic condition of firms. Lund (2000) shows how tax systems and imperfect loss-offset influence the corporations´ required pre-tax rate of return.

Several analyses of the German loss-offset limitation show the negative effects on the business sector, especially on corporations, on firms with a tight liquidity position and on firms with volatile or cyclical returns (e.g. Bach/Haan/Maiterth/Sureth (2004); Kraft/Krengel (2004)). Van Wijnbergen/Estache (1999) use Brazilian data to analyze a minimum asset tax on companies. They prove that the reproach is unjustified that risky companies are discriminated because of a higher tax burden due to minimum taxation. In certain constellations under uncertainty marginal effective taxation can even decrease under uncertainty. Here, and in the research of Lyon (1997), it becomes obvious that the influence of capital intensity in different economic sectors is an important value driver. If the taxpayer cannot pay the tax from permanent income and has to fall back on their wealth, minimum taxation is similar to a wealth tax. Niemann (2004b) analyzes asymmetric taxation in a cross-border study. He investigates the impact on cross-border investment decisions of firms of the Austrian corporate minimum tax and loss-offset rules. Gérard/Weiner (2003) show that in cross-border scenarios investments are not hindered by implementing a loss-offset limitation in countries with high tax rates.

Sureth/Maiterth (2008) analyze a similar concept - a wealth tax that can be imputed against profit taxes. They point out that financial investments are, relatively speaking, preferred over real investments. Lyon/Silverstein (1995) study the impact of the CAMT on multinational corporations. Furthermore, Niemann/Treisch (2005) investigate the impact of the Austrian group taxation and loss-offset limitation on multinationals' cross-border investments.

Until now all analyses were limited to only one or two forms of minimum taxation and their impact on decisions. For the first time, we integrate the current existing different income-related concepts of minimum taxation into one comprehensive model and analyze their influence on corporate behavior, especially on corporate investment decisions. Therefore, we introduce the concepts of the various countries and develop one set of equations in section II. Using dynamic capital budgeting on the basis of a complete financial plan in section III we analyze the different concepts and their impact on real investment in comparison to the alternative capital market investment under certainty. We present the basic model in section III.1 and perform numerical analyses for different cash flow patterns in section III.2. The research design is extended to account for uncertainty. We use a Monte Carlo simulation in section III.3 to generate series of stochastic cash flows. We run a sensitivity analysis in section III.4 to derive information for a more general setting. On this basis, we are able to isolate the effects of minimum taxation only and draw quantitative conclusions about the impact of different minimum tax concepts. Finally, we show which concept causes the fewest distortions and thereby provide interesting information for tax reform discussions. In section IV we summarize and draw final conclusions. Our results are useful for corporate investors when deciding on the location and type of single investment projects, and contribute to the European tax discussions. They can be used for further analyses on cross-border investments of multinationals.

# II CONCEPTS OF MINIMUM TAXATION IN DIFFERENT COUNTRIES

In this section the rules of the selected countries - Germany, Austria, Brazil, Poland and the USA - are introduced. Against this background we can then set up a model that serves to analyze the tax effects of the different minimum taxation concepts. The design of the particular tax codes with credits, depreciation, tax allowances etc. remains unconsidered, as long as they have no direct influence on minimum taxation itself. We focus on companies that are corporations and direct our focus only on the level of taxation of the company.

## 1 GERMAN MINIMUM TAXATION AS A LOSS OFFSET LIMITATION

With income tax revenue dropping from almost €160 billion to €147 billion in the 1990s, depreciation models and loss carry-forwards have attracted notice in several

tax reform discussions. The existing rules for periodical and interperiodical complete loss offset were reformed by the new German Tax Relief Act (1999, 2000, 2002)[2] that introduced a new minimum taxation.

Now, in Germany loss carry-backs are restricted to the immediately prior period and limited to €511,500. Thereafter, non-compensated losses can be carried forward unrestrictedly up to an amount of €1 million.[3] This base amount is used to ensure a complete loss offset for low and medium income and therefore is referred to as the middle class component. Moreover, only 60% of the positive income of the current assessment period can be offset against the negative income of the previous year. This statutory restriction applies to corporations as well.[4,5]

Therefore, minimum taxation occurs only if total income and the loss carry-forward exceed the mentioned threshold. Accordingly, and depending on the value of the above mentioned amounts, different tax consequences can emerge in Germany:

1. normal taxation,
2. zero taxation and
3. minimum taxation.

Normal taxation occurs when the loss carry-forward is less than the total income. This setting produces two possibilities. First, when the loss carry-forward does not exceed the base amount losses can be completely offset. Second, when the base amount exceeds the loss carry-forward by no more than 60% of total income, the loss carry-forward is also completely deductible. We get zero taxation if the loss carry-forward is greater than total income and also less than the base amount. In that case the tax base is reduced to zero. No negative tax base can result. In all other cases minimum taxation emerges, because not all existing carry-forwards can be offset and therefore the tax base shows a too high value. The remaining loss carry-forward is carried forward into the next assessment period. The consequences can be described by the following equations.[6]

Ad 1.: **Normal taxation**.

$If\ €1M \geq L_t < TI_t$
$or\ TI_t > €1M < L_t \leq [€1M + (TI_t - €1M) \times 0.6]$
then

(1) $G_{\tau,t} = (1-\tau)(TI_t - L_t)$,

where
$G_{\tau,t}$: gains after taxes in $t$,
$t$: time index,
$\tau$: income tax rate,

[2] Steuerentlastungsgesetz 1999, 2000, 2002.
[3] Cf. section 10d para 2, no. 2 EStG (German Income Tax Code).
[4] Cf. section 8 para 1 KStG (Corporate Income Tax Act) and section 10a GewStG (Trade Tax Act).
[5] But a loss carry-back is still not allowed under trade tax (GewSt).
[6] The possibility of loss carry-backs is ignored in this model as it is an ex-post consideration and only few other countries allow for such an offset.

$TI_t$: total income in $t$,
$L_t$: loss carry-forward in $t$, accumulated loss carry-forward in $t$.

Ad 2.: **Zero taxation**.

$If\ €1M \geq L_t \geq TI_t$

then

(2) $G_{\tau,t} = (1-\tau)(TI_t - L_t)$,

where

(3) $TI_t - L_t = 0$.

Moreover, remaining losses that are not offset $(L_t - TI_t)$ are carried forward to the following period.

Ad 3.: **Minimum taxation**.

$If\ L_t > [€1M + (TI_t - €1M) \times 0.6] < TI_t$,

where

$TI_t > €1M$,

then

$(4a)\ G_{\tau,t} = (1-\tau)(TI_t - €1M - (TI_t - €1M) \times 0.6)$,

$(4b)\ G_{\tau,t} = (1-\tau)[(TI_t - €1M) \times\ 0.4)$.

By using a generalized illustration of earnings after tax $(G_{\tau,t})$ as the difference between tax base $(W_t)$ and tax payable $(\tau \times W_t)$, the three mentioned cases can be integrated into one comprehensive equation:

(5) $G_{\tau,t} = (1-\tau)W_t$,

where[7]

(6) $W_t = \max\{0; TI_t - L_t; \alpha \times (TI_t - \beta)\}$,

with
$\alpha$: minimum taxation rate=0.4,
$\beta$: base amount=€1M.

[7] Cf. Niemann, R. (2004c), p. 363.

This equation can be compared to corresponding equations for other countries that will be discussed in the following sections.

## 2 The Austrian Corporate Minimum Taxation and Loss Offset Limitation

In 1994 the Austrian government introduced a new corporate minimum tax as a consequence of decreasing public revenues. After some changes today's minimum tax rate stands at 5% of the statutory minimum capital of the company. That said, limited liability companies are subject to an annual minimum taxation of €1,750, corporations to €3,500 and Societas Europaeas (SE) to €6,000, if no greater tax liability arises from the regular tax system based on current profits.[8] The paid minimum tax can be charged against regular corporate income tax in the following years. In the course of the last tax reform (2005) the corporate tax rate was lowered from 34% to 25%. Under the regular tax rate, a tax base of €7,000 results in a tax burden of €1,750. Lower income leads to minimum taxation and in turn, to a higher tax rate. For example, if the income of a limited liability company is less than €1,750 assets have to be liquidated to pay the tax as there are no available profits (non-profit oriented taxation). Even if the paid minimum tax can be credited against tax due in the following years, minimum taxation not only implies an interest effect, but under certain circumstances the risk of losing assets (substance) arises, e.g., in case of several consecutive years of losses.

The Austrian loss offset policy has always been more restrictive than the German policy. The tax code neither allows for loss carry-backs nor unlimited loss carry-forwards until 1996. Section 2 para 2b ÖEStG (Austrian Income Tax Law) in 2001 restricted the loss offset possibility. An offset limit of 75% of the positive income of the assessment period was implemented.[9] Since the Austrian tax law, in comparison to Germany, does not allow for a base amount, **zero taxation** is impossible in either case. As soon as positive income is achieved, the treasury receives 25% as a corporate tax. Even if the allowable amount of the already paid minimum tax matches the regular tax liability, no zero taxation is possible because, in general, the regular tax can only be reduced by a minimum tax credit up to the minimum tax limit of 25%.[10] Therefore, it becomes apparent that for some companies a belated set-off of the minimum tax not only has a negative interest effect – an offset could instead be omitted entirely.

Therefore, in Austria two taxation scenarios can occur. As an example we use the legal form of a SE. This legal form offers some advantages, as it is a beneficial institutional framework for a company with cross-border operations and for

[8] During the startup phase, the amount decreases to € 1,092 irrespective of the legal form.
[9] Section 2 para 2b ÖEStG distinguishes between an offset limit and a carry-forward border. The former is applied to non-compensable losses (section 2 para 2b no. 2 ÖEStG), where 75% of these losses can only be offset with positive earnings from the same income source. The rest must be carried forward. All compensable losses are clearable against 75% of the positive income (section 2 para 2b no. 1 ÖEStG). This is referred to as the carry-forward border. In the following analysis only compensable losses are considered.
[10] Cf. section 24 para 4 no. 4 ÖKStG (Austrian Corporate Tax Law).

multinational groups. The subsequent equations can be easily adjusted for any other legal form.

**Normal taxation** takes place if the loss carry-forward does not exceed 75% of total income ($TI_t$) and total income after losses and the minimum tax credit divided by the tax rate $\frac{MC_{\gamma,t}}{\tau}$ is greater than €24,000.

Therefore,

$$iff\ L_t \leq 0.75 \times TI_t \geq €17{,}000 + 0.75 \times L_t + 0.75 \times \left(\frac{MC_{\gamma,t}}{\tau}\right)^{11}$$

and thus $TI_t - L_t - \left(\frac{MC_{\gamma,t}}{\tau}\right) \geq €24{,}000$.

Then

(7) $G_{\tau,t} = (1-\tau)(TI_t - L_t) - MC_{\gamma,t}$,

where
$MC_{\gamma,t}$: Minimum tax credit in t.

In Austria **minimum taxation** appears in two different forms. Firstly, we find minimum taxation because of the loss offset limitation and secondly, because of the corporate level minimum taxation. Both forms of minimum taxation can only occur alternatively, as the corporate minimum tax is applied after the calculation of the total income. A limited loss offset indeed is considered during the determination of the total income. The resulting total income does not serve as the tax base if it is less than €24,000. However, if the threshold of €24,000 is not reached, as formally illustrated by the following equations:

**Minimum taxation by loss offset limitation:**

$$Iff\ L_t > 0.75 \times TI_t \geq €17{,}000 + 0.75 \times L_t + 0.75\left(\frac{MC_{\gamma,t}}{\tau}\right),$$

and thus $TI_t - L_t - \left(\frac{MC_{\gamma,t}}{\tau}\right) \geq €24{,}000$.

Then

(8) $G_{\tau,t} = (1-\tau)TI_t \times 0.25 - MC_{\gamma,t}$.

**Corporate minimum taxation:**

$$Iff\ TI_t - L_t - \left(\frac{MC_{\gamma,t}}{\tau}\right) < €24{,}000,$$

then

(9) $G_{\tau,t} = TI_t - \tau \times €24{,}000$.

Through minimum taxation, a negative after-tax return ($G_{\tau,t}$) can emerge. If $G_{\tau,t} < 0$ taxation of substance or wealth results.

Here, the functional relation of the return and the minimum taxation in line with eqs (5) and (6) in the German case can also be shown parametrically:

(10) $G_{\tau,t} = (1-\tau)W_t$,

where

(11) $W_t = max\left\{TI_t - L_t - \left(\frac{MC_{\gamma,t}}{\tau}\right); \alpha \times TI_t - \left(\frac{MC_{\gamma,t}}{\tau}\right); \frac{\gamma}{\tau_\gamma}\right\}$,

with
$\alpha$: minimum tax rate=0.25,
$\gamma$: minimum tax liability=€6,000,
$\tau_\gamma$: tax rate in Austria=0.25,
$MC_{\gamma,t}$: minimum tax credit.

If the maximum of $W_t$ is $\frac{\gamma}{\tau_\gamma}$, then we have a minimum tax liability of €6.000, which clarifies that taxation of substance or wealth takes place and a negative after-tax return ($G_{\tau,t}$) occurs.

It is obvious that the Austrian minimum taxation ties up to the tax base in two ways. Firstly, losses cannot be offset totally and secondly, according to the regulations for determining total income, a minimum tax base is presumed even if the real company pre-tax gains and therefore the regular tax base is lower. A special feature of the Austrian tax code is the carry-forward minimum tax credit, which is a prepayment of taxes allowable in the following periods. If taxable income after a loss offset is greater than the minimum tax base, a minimum tax credit is deductible, but only until the minimum tax is reached. This rule implies that after a limited loss offset an existing minimum tax credit is not necessarily completely depleted. Therefore, a separate calculation for the loss offset and the minimum tax credit is necessary to remember remaining minimum tax credits in future.

## 3 LIMITED LOSS OFFSET IN BRAZIL

In Brazil, gains and losses are subject to asymmetric treatment. An intertemporal loss offset can only occur in the following period; the Brazilian tax code does not allow for carry-backs. Minimum taxation is the outcome of the limitation of the loss offset allowance to 30% of taxable income of the following time period. Apart from a few special situations (e.g. mergers, spin-offs etc.) where a loss can expire, a loss can be carried forward unrestrictedly in any of the following periods.[11] In this concept zero taxation, as a consequence of a reduction in taxable income by the loss carry-forward to zero, is not possible. As a result two taxation scenarios can occur:

[11] Cf. Endres, D./Naumburg, C./Welling, B. et al. (2006), p. 87, Guelman, A. (2004), p. 3.

**Normal taxation** takes place if there is no loss carry-forward or if the loss carry-forward does not exceed 30% of total income ($TI_t$).[12]

$Iff\ L_t \leq 0.3 \times TI_t$

then

(12) $G_{\tau,t} = (1-\tau)(TI_t - L_t)$.

**Minimum taxation** emerges in all other cases. When taxation takes place even though loss carry-forwards still exist, they cannot be offset in the current period. This constellation is illustrated by the following equations:

$Iff\ L_t > 0.3 \times TI_t$

then

(13) $G_{\tau,t} = (1-\tau)[TI_t - (0.3 \times TI_t)]$.

By using the equation developed in the previous section[13], we have:

(14) $G_{\tau,t} = (1-\tau)W_t$,

where

(15) $W_t = \max\{TI_t - L_t; TI_t\}$,

with
$\alpha$: minimum taxation rate=0.7.

Under the assumption $\alpha = 0.7$, the set of equations describes a minimum taxation rule that corresponds to the parameter $\alpha$ in the German concept. The difference between the two concepts arises from the German base amount $\beta$. Such a base amount has not been introduced in the Brazilian tax code, so zero taxation is impossible.

## 4 The Limitation of Loss Offset in Poland

In the course of integrating Poland into the EU the Polish government reformed its tax codes in 1992. Several improvements were introduced that aimed to make the system more efficient and more comparable to that of the EU Member States. In this context new loss-offset regulations were implemented. Losses sustained after 12/31/1998 can be carried forward for five years. However, only 50% of the originally incurred losses in the following years can be offset.[14] Hence, the earliest period a carry-forward can be utilized is two assessment periods after the occurrence

[12] In this case, too, $L_t$ is the sum of all loss carry-forwards.
[13] See eqs (5) and (10).
[14] Or rather, the accumulated loss carry-forwards of the last 5 years.

of the loss. A remaining loss carry-forward expires after five years.[15] Through this regulation, a minimum taxation can emerge under specific circumstances.

**Normal taxation** takes place if no loss carry-forward exists. So we have:

(16) $G_{\tau,t} = (1-\tau)TI_t$.

**Zero taxation** occurs when the gains of one year constitute at most half of the loss carry-forward or constitute the accumulated, unhalved, originally incurred loss carry-forwards. For simplicity it is assumed that loss carry-forward $L_t$ corresponds to the above mentioned sum of the unhalved, originally incurred loss carry-forwards.

$If\ TI_t \leq 0.5 \times L_t$

then

(17) $G_{\tau,t} = (1-\tau)(TI_t - L_t)$,

where

(18) $(TI_t - L_t) = 0$.

**Minimum taxation** emerges in all other cases, i.e. if taxation takes place although unused loss carry-forwards exist but cannot be offset.

This scenario is given
$iff\ TI_t > 0.5 \times L_t$,

then

(19) $G_{\tau,t} = (1-\tau)(TI_t - (0.5 \times L_t)]$.

It can be illustrated by the previously used equation:[16]

(20) $G_{\tau,t} = (1-\tau)W_t$,

where

(21) $W_t = \max\{0; TI_t - (\delta \times L_t)\}$,

with
$\delta$: loss offset rate=0.5.

Under the given set of assumptions $\delta$ describes a minimum coefficient that approximates the German minimum taxation rate. However, $\delta$ does not refer to total income ($TI_t$) but to loss carry-forward ($L_t$).

[15] Cf. Endres, D./Naumburg, C./Welling, B. et al. (2006), p. 68, Kudert, S. (2001).
[16] See eqs (5) and (6), (10) and (11) as well as (14) and (15).

## 5 THE CORPORATE ALTERNATIVE MINIMUM TAX IN THE USA

Whereas the above mentioned tax systems include minimum taxation in the form of a limitation of the intertemporal taxable loss compensation, the USA features another form by providing surety of a taxation of substantial income.

The 1978 Revenue Act[17] introduced a new system, the alternative minimum tax. This system, which requires the calculation of a separate tax base, was initially applicable only to individual persons but was extended to corporations in 1986. This system change was accompanied by some subsidy reductions, which were to ensure that tax subjects with major economic gains at least contribute a minimum amount to the national venue. The system with adjusted current earnings, i.e. an allowance for corporate equity (ACE), was implemented in this context, too. The ACE does not apply to the regulations of the Internal Revenue Code (IRC). Rather, it represents a complex parallel system of adjustments and preferences. 75% of the difference between ACE and the corporate alternative minimum taxable income (CAMTI) are an add-on to the tax base of the CAMT (corporate alternative minimum tax).[18]

Minimum taxation of corporations is based on three principles that are used side by side. The **parallel world concept** indicates that in all cases both tax bases have to be calculated, so the regular and the AMT system must be considered.[19] An additional tax due under the CAMT only occurs if the regular tax due ($TI_t \times \tau$)is less than the tentative minimum tax (TCAMT). Because of this, a divergence between economic and taxable income should be avoided.

The **10% floor concept**, as the second concept is known, refers to the loss offset that is integrated into the CAMT concept. According to Section 172(c) IRC a net operating loss (NOL) is defined as a backlog of allowable deductions over gross income. In the range of the regular income tax a loss carry-back is limited to two years and a carry-forward to 20 years.[20] Furthermore, losses of passive activities[21] cannot be offset against positive incomes of active activities.[22] The CAMT has its own loss offset rules, as mentioned in the 10% floor concept. On the one hand, it indicates that losses from other assessment periods cannot reduce the tax due below 10%.[23] On the other, the offset of foreign losses is limited. Global income is the basis for calculating the tax liability in the United States. To prevent double taxation the USA regularly uses a tax credit for taxes paid in other countries.[24] Here, too, the foreign tax credit (FTC) can reduce the maximum tax liability up to 90%.[25]

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[17] In 1969 the add-on minimum tax and in 1978 the current existing minimum taxation was implemented.
[18] Cf. sec. 55(g) (1) IRC, Lyon, A. (1997), pp. 21.
[19] Cf. sec. 56(d) IRC.
[20] Cf. Endres, D./Naumburg, C./Welling, B. et al. (2006), p. 15.
[21] See sec. 469(c) IRC. There are two kinds of passive activity: 1. rentals, including equipment leasing and rental real estate and 2. businesses in which the taxpayer does not materially participate (includes activities on Schedules C or F and from partnerships, S Corporations and LLCs.
[22] E.g. interests in a limited partnership.
[23] Cf. sec. 56(d) IRC.
[24] Foreign incomes are included in the tax base. Withholding tax is, however, deductible as a foreign tax credit (FTC).
[25] Cf. Lyon, A. (1997), p. 32, 33.

The third and last concept is the **prepayment concept**, which enables the paid AMT to be credited against the regular tax due in the following years. In the form of a carry-forward, the corporate alternative minimum tax credit (CAMTC) is clearable. However, tax rules frequently change due to tax reforms and have to be considered case by case. Thus, a credit that possibly differs from the paid amount cannot be imputed in the year a CAMT occurs.

Every corporation can deduct an exemption amount of $40,000 (€25,000[26]) of its CAMTI.[27] This amount shall be reduced (but not to below zero) by an amount equal to 25% of the amount by which the alternative minimum taxable income of the taxpayer exceeds $150,000 (€93,750).[28] With a CAMTI of $310,000 (€193,750) the exemption amount is reduced to zero.[29,30]

The last tax reforms introduced a number of major changes, of which only the most important are mentioned here. Under sec. 448c IRC since 1998 small companies have been exempt from the CAMT provided their gross income of the last three years was less than $5M. As long as income in the following periods does not exceed $7.5M, the tax exemption persists. The tax rate of the CAMT is 20%. As the corporate income tax scale is progressive, results vary from state to state and depend on the company situation. Therefore, general statements are impossible.

The following equation allows us to quantify the after-tax return:

$$(22)\quad G_{\tau,t} = (1-\tau)(TI_t - L_t) + MC_{\varepsilon,t} - CAMT,$$

where

$$(23)\quad MC_{\varepsilon,t} = \begin{cases} 0 & \text{iff CAMT} > 0, \\ \min\left\{MC_{\varepsilon,t-1} + CAMT_{t-1}; \tau \times (TI_t - L_t)\right\} & \text{otherwise,} \end{cases}$$

$$(24)\quad \mathrm{E} = \begin{cases} €25{,}000 & \text{iff } CAMTI_t \leq €93{,}750, \\ €25{,}000\text{-}\left(0.25 \times (CAMTI_t\text{-}€93{,}750)\right) & \text{iff } €93{,}750 < CAMTI_t < €193{,}750, \\ 0 & \text{otherwise,} \end{cases}$$

$$(25)\quad CAMT = max\left\{0; \left((CAMTI_t - E) \times \tau_{CAMT}\right) - (\tau \times (TI_t - L_t)\right\},$$

with

| | |
|---|---|
| $CAMT$: | corporate alternative minimum tax, |
| $CAMT_{t-1}$: | corporate alternative minimum tax in t-1, |
| $CAMTI_t$: | corporate alternative minimum tax income, tax base, |
| $E$: | exemption amount, |
| $MC_{\varepsilon,t}$: | minimum tax credit in t, |
| $MC_{\varepsilon,t-1}$: | minimum tax credit in t-1, |
| $\tau_{CAMT}$: | tax rate of the CAMT system. |

[26] An exchange rate of €1 = $1.6 is assumed.
[27] Cf. sec. 55 para. D no. 2 IRC.
[28] Cf. sec. 55 para d no. 3A IRC.
[29] Cf. Dworin, L. (1987), p. 506.
[30] Legal situation in 2007.

The after-tax gains are calculated by the tax base $(TI_t - L_t)$ minus the tax liability, increased by the minimum tax credit and reduced by *CAMT* (eq. (22)). Thus, alternative minimum taxation only occurs if the tentative tax liability of the CAMT system is greater than the tax liability under regular income taxation. The total tax liability is composed of the regular tax itself and the *CAMT* in the form of the difference of the above mentioned amounts. Furthermore, a deduction of an existing credit is dependent on an occurring *CAMT*. Only if no *CAMT* arises the credit can be offset (eq. (23)). Basically, three different taxation scenarios can be distinguished, in analogy to Germany and Poland, regarding the effect of the CAMT:

1. normal taxation,
2. zero taxation and
3. minimum taxation.

Ad 1.: **Normal taxation.**

$$if \sum_{t=-1}^{1} TI_t < \$5M \; and \; MC_{\varepsilon,t} < \tau \times (TI_t - L_t)$$

$$or \sum_{t=-1}^{1} TI_t > \$5M, L_t > TI_t, CAMT - E = 0 \; and \; MC_{\varepsilon,t} < \tau \times (TI_t - L_t)$$

then

(26) $G_{\tau,t} = (1-\tau)(TI_t - L_t)_t + MC_{\varepsilon,t}.$

Ad 2.: **Zero taxation.**

$$If \sum_{t=-1}^{1} TI_t < \$5M \; and \; L_t \geq TI_t$$

$$or \sum_{t=-1}^{1} TI_t < \$5M \; and \; MC_{\varepsilon,t} \geq \tau \times (TI_t - L_t)$$

$$or \sum_{t=-1}^{1} TI_t > \$5M, \; L_t > TI_t \; and \; CAMT - E = 0,$$

then

(27) $G_{\tau,t} = 0.$

Ad 3.: **Minimum taxation.**

$$If \sum_{t=-1}^{1} TI_t > \$5M \; and \; CAMT - E = 0$$

then, the developed equation applies completely:

(28) $G_{\tau,t} = (1-\tau)(TI_t - L_t) - \left[\left((CAMTI_t - E) \times \tau_{CAMT}\right) - \left(\tau \times (TI_t - L_t)\right)\right].$

Unambiguous conclusions about whether or not substance taxation emerges cannot be drawn, as it depends on the proportion of the *CAMT* and the true economic income. If the *CAMT* exceeds business income in the regular tax system the tax has to be paid out of the substance of the company.

By using the taxable base $W_t$, we get the simplified equation:

(29) $G_{\tau,t} = W_t - (W_t \times \tau) + MC_{\varepsilon,t} - CAMT,$

where

(30) $W_t = max\{0; TI_t - L_t\},$

(31) $MC_{\varepsilon,t} = \begin{cases} 0 & iff\ CAMT > 0, \\ min\{MC_{\varepsilon,t-1} + CAMT_{t-1};\ \tau \times (TI_t - L_t)\} & otherwise, \end{cases}$

(32) $CAMT = max\{0; [(CAMTI_t - E) \times \tau_{CAMT} - (W_t \times \tau)]\}.$

This minimum tax concept does not focus on taxable income, but on the difference between the tax liability under regular taxation and the CAMT. Due to this difference, the minimum taxation parameter $\varepsilon$ that will be introduced in the following equation is a combination of a minimum tax base and a minimum tax rate. This parameter covers the adjustments and preferences provided by the regular tax base in comparison to the CAMT, and also incorporates the AMT tax rate of 20%. Integrating these facts into the above concept of regular taxation for comparison purposes leads to:

(33) $G_{\tau,t} = (1 - \tau)W_t + MC_{\varepsilon,t} - \varepsilon,$

where

(34) $W_t = \max\{0; TI_t - L_t\}$ and

(35) $\varepsilon = max\{[(CAMTI_t - E) \times \tau_{CAMT}] - (W_t \times \tau); 0\},$

with
$\varepsilon$: CAMT liability.

## 6 THE COMPREHENSIVE MODEL

Integrating all former developed equations into one model leads to the following overall equation that can be used for further analyses. By setting the other parameters to zero one can create a relevant equation for each country.

(36) $G_{\tau,t} = (1 - \tau) \times W_t + MC_{\varepsilon,t} - \varepsilon\ ,$

where

(37) $W_t = max\left\{0; TI_t - (\delta \times L_t) - \left(\frac{MC_{\gamma,t}}{\tau}\right); \alpha \times (TI_t - \beta) - \left(\frac{MC_{\gamma,t}}{\tau}\right); \gamma_1\right\}$

with
$\alpha$: minimum taxation rate,
$\beta$: base amount,
$\gamma_1$: minimum tax base = $\frac{\gamma}{\tau_\gamma}$,
$\delta$: loss offset rate,
$\varepsilon$: CAMT liability,
$MC_{\varepsilon,t}$: minimum tax credit of $\varepsilon$,
$MC_{\gamma,t}$: minimum tax credit of $\gamma$.

# III Numerical Analysis

## 1 THE MODEL

Since loss-offset limitation rules are not linear and condition-based, a numerical analysis is necessary to evaluate investments with temporary losses.[31] Extending the model of Niemann (2004c) the impact of the above outlined loss-offset limitations on the profitability of real or financial investment can be shown.

Let us analyze the following scenario: An investor has to decide in period ($t = 0$) whether to spend their equity capital $I_0$ on a real investment or a financial investment. The financial investment earns interest at the constant pre-tax yield of i, whereas the real investment yields the following cash flows $CF_t$ ($for\ t = 1, \dots, T$) for the whole time horizon $T$. The investor aims to maximize the future value of the investment.

As a perfect capital market is assumed, the pre-tax debit interest rate for borrowing is identical to the pre-tax credit interest rate $i$.[32] The return on the capital market or real investment is reinvested at the pre-tax market rate of return into the originally chosen investment project (financial or real investment). Hence, income from the realized investment project will be reinvested in the type of investment carried out in $t = 0$. Thus, the decision is assumed to be irreversible during the planning horizon. The investment will be liquidated at the end of the time horizon $T$, at which point the investor receives the accumulated (future) value. No extra taxation arises from this liquidation as we assume liquidation at book value and thus no capital gains.

The investor is a company with the legal status of a corporation. We abstract from taxation at shareholder level in our analysis and focus on the corporate level. As we assume heterogeneous shareholders (individual and institutional) of the investing corporation it is not possible to find one representative tax rate. Instead, the shareholder will have various personal tax rates. Against this background, abstracting from the shareholder level is a justified simplification for our research question and enables us to concentrate on the major impact of minimum taxation on the corporate level.

[31] Cf. Niemann, R. (2004a), p. 363.
[32] Hence, interest income is fully taxable.

We assume the simplest form of loss offset restriction in the underlying tax system, i.e., only positive tax bases are subject to the combined tax while negative tax bases are not tax-deductible. In this scenario, losses do not lead to an immediate tax refund but can be transferred to future periods via a loss carry-forward. The possibility of loss carry-backs, as implemented in Germany, is ignored for reasons of simplicity. It can be easily shown that its impact on the profitability of an investment is very low[33] and only few countries use this type of loss-offset rule. Moreover, in our model no possibility of a loss carry-back is given, as we only assume positive cash flows after $t = 0$. Furthermore, we introduce a tax system with a complete loss offset which serves as a yardstick. Here, a tax refund in case of losses and a tax liability in case of gains are assumed.

While the influence of the chronological order of losses and their impact on the financial situation of companies has already been investigated in general,[34] we focus on a comparison of the different concepts of minimum taxation and their impact on investment decisions. Therefore, we assume that at the point of decision ($t = 0$) a loss carry-forward ($L_0$) of the taxpayer from former years already exists and is tax-deductible.[35]

Integrating all mentioned minimum taxation into our base tax framework, we can focus on effects of different types of minimum taxation and simultaneously abstract from the effects of other tax rules in the national tax codes.[36]

To eliminate tax rate or other tax base effects we refer to an overall corporate tax rate $\tau$ and an overall tax base for all countries. Moreover, linear depreciation is assumed, as in most countries this is the only applicable depreciation method for tax purposes.[37] Tax life is assumed to be identical to economic life and equals the time horizon $T$. Beyond depreciation allowances no other non-cash accruals exist.

Thus, we get:

(38) $G_{\tau,t} = (1 - \tau)W_t$,

where

(39) $W_t = CF_t - D_t - L_t$

with

$CF_t$: cash flow generated from the investment in $t$,

[33] According to the analysis by Haegert, L./Kramm, R. (1977), p. 209 and Dwenger, N. (2008), p. 20.
[34] E.g. Bach, S./Haan, P./Maiterth, R./Sureth, S. (2004), Groß, S./Steiger, J. (2004), Herzig, N./Wagner, T. (2004), Intemann, J./Nacke, A. (2004), Kraft, G./Krengel, R. (2004).
[35] It is assumed that these losses are deductible and there is no shell company sale. This setting is in line with the model of Niemann (2004c).
[36] To isolate effects due to the minimum concepts we ignore that a loss offset-limitation may be interdependent with other tax rules of the respective country. E.g., the level of the American CAMT is influenced by factors such as engaged subsidies, depreciation and others.
[37] Since 2008 only linear depreciation for new purchased assets has been allowed in Germany. In case of the U.S. system it is assumed that an economic life of ten years is allowed under both the regular tax system and CAMT. This assumption enables us to abstract from effects caused by depreciation. For depreciation adjustments see Section 56 (g) (4) (i) IRC.

$D_t$: depreciation in $t$,
$L_t$: loss carry-forward in $t$.

## 2 ANALYSIS OF DETERMINISTIC CASH FLOWS

In the following analysis the complete finance plan is set up to determine the future value. As a reference model or yardstick a symmetric tax treatment of gains and losses is chosen. Here, a complete loss offset with tax refund in case of losses and a tax liability in case of gains is assumed.[38] Therefore, we compare the future value of the financial investment with the future value of the real investment under limited and complete loss offset as an indicator of the influence of the loss offset restriction rules. Here, the financial investment serves as a proxy for the best alternative investment without loss offset restrictions.

To isolate the tax effects from minimum taxation and to compare the alternatives, we have to assume identical pre-tax future values $FV_{p-t}$ for identical investment

amounts $I_0$.[39] Given this set of assumptions, we determine recursively the cash flow stream for the real investment project that leads to the same pre-tax future value as the alternative financial investment. On this basis it is possible to isolate the effects of different loss-offset restrictions on real investment decisions. Numerical examples with varying cash flow time structures but identical pre-tax yields of the projects provide an in-depth insight into the interdependencies of cash flow pattern and minimum tax concepts.

The following assumptions are made within the basic scenarios:

| Fixed parameters | |
|---|---|
| Interest rate | $i = 0.1$ |
| Tax rate | $\tau = 0.3$[40] |

[38] Cf. Niemann, R. (2004a), p. 363. If we account for interests at the market rate for each period with a loss carry-forward instead of assuming a tax refund, the same result would emerge.

[39] Another way could be to assume the same after-tax future value for both investment alternatives, but this approach would eliminate the interdependencies of the loss-offset and the depreciation effect. The latter effect indeed has a huge impact on the effects of minimum taxation concepts, as shown in the following analyses.

[40] If we take Germany as a proxy for many countries' tax systems this tax rate is given by the German corporate income tax rate of 15%, the German solidarity surcharge of 5.5% on the corporate income tax and the German local business tax rate of 13.69%. The tax rate of 30% can be regarded as representative as 30% is the average nominal tax rate in the European Union. The tax scale of the local business tax is composed of the federal local business tax rate for corporations that is 3.5% (cf. section 11 para. 2 no. 2 GewStG 2008) and a local multiplier of 391% (391% was the average local rate in Germany in 2006. Cf. German Federal Statistical Office (2007), from 10/24/07, under: www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Presse/pm/2007/08/PD07_329_735,templateId=renderPrint.psml. Therefore, the effective business tax rate is $\tau^{bt,eff.} = (3.5\% \times 391\%)100\% = 13.69\%$. It follows that $\tau$=15%+0.825%+13.69%=29.52% (with 5.5% of 15% corporate income tax = 0.825%). Therefore, the combined tax rate to be used in our analysis is set at

| | | |
|---|---|---|
| Time horizon | | $T = 10$ |
| Initial outlay | | $I_0$ = €8M |
| Depreciation ($D_t = I_0/T$) | | $D_t$ = €0.8M |
| Initially given loss carry-forward | | $L_0$ = €3M[41] |
| Pre-tax future value (for financial and real investment) | | $FV_{p-t}$= € 20,749,939.68[42] |
| Variable parameters | | |
| Constant cash flows | | $CF_t$= €1,301,963.16[43] |
| Increasing cash flows | Cash flow in $t$=1 | $CF_1$ = €370,796[44] |
| | growth rate | $g_i$ = 1.3 |
| Decreasing cash flows | Cash flow in $t$=1 | $CF_1$ = €3.235M[45] |
| | growth rate | $g_d$ = -0.3 |

**Table 1:** Overview of the assumptions of the deterministic analysis

## 2.1 CONSTANT CASH FLOWS

Based on the above given set of assumptions our scenario is characterized by a constant series of cash flows amounting to €1.302M[46] as the annual cash flow.

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$\tau$=0.3. The fact that the tax base for business tax differs from the corporate tax base is not considered in detail, so the calculated tax rate is an approximated usable rate.

[41] The chosen amount needs to be as big as the minimum tax in all concepts and less than a loss-carry-forward remains at the end of the time horizon. By setting $L_0 = €3M$ it exceeds the German base amount of €1M and leads to no remaining loss carry-forwards in *T*. The lower level approximates a total loss offset, while a higher one approximates a tax-free case. Cf. Niemann, R. (2004c), p. 361.

[42] We assume the pre-tax future value of both investments is €20.75M. This amount is the future value we receive for an investment of €8M at the capital market at an interest rate of 10%. Therefore, we assume the initial outlay is $I_0 = 8M$.

[43] Based on the other assumptions these constant cash flows lead to the same pre-tax future value like in case of a financial investment.

[44] With the exogenously given growth rate of 1.3 the first cash flow has to be €370.796 to achieve a pre-tax future value of €20,749,939.68.

[45] With the exogenously given growth rate of 0.3 the first cash flow has to be €3.235M to achieve a pre-tax future value of €20,749,939.68.

The following table summarizes the results of the analysis. The second column shows the future values of the financial investment and the third one the differences between the future value of the particular minimum concept (denoted by $\Delta_1$) and the future value of the complete loss-offset after tax (first field in the second column). The fourth and the fifth column show the corresponding values for the real investment. In the last column we see that usually the real investment is advantageous in comparison to the financial alternative (denoted by $\Delta_3$), as it shows the difference between the real and financial investment. A negative (positive) amount presents the discrimination (advantage) in comparison to the financial investment.

| | FV F | $\Delta_1=FV_F^l-FV_F^c$ | FV R const. | $\Delta_2=FV_R^l-FV_R^c$ | $\Delta_3= FV_R^l-FV_F^l$ |
|---|---|---|---|---|---|
| **Complete l-o** | 17.508 | / | 17.678 | / | 0.171 |
| **Germany** | 17.257 | -0.251 | 17.370 | -0.308 | 0.114 |
| **Austria** | 17.207 | -0.301 | 17.317 | -0.361 | 0.110 |
| **Brazil** | 16.974 | -0.534 | 17.098 | -0.581 | 0.124 |
| **Poland** | 17.257 | -0.251 | 17.304 | -0.374 | 0.047 |
| **USA** | 17.248 | -0.259 | 17.362 | -0.316 | 0.114 |

FV: future value, F: financial investment, R: real investment, l-o: loss-offset, l: limited loss offset and c: complete loss-offset.

**Table 2:** Future values of financial and real investments for constant cash flows in €M

Under the given set of assumptions, introducing taxes into the reference model of a complete loss-offset turns the identical pre-tax result of both investments into a relative advantage of the real investment. This effect is shown by the positive value, i.e. in the after-tax advantage of the real investment in case of a complete loss-offset (last column: 0.171). This distortion is caused by a classic tax paradox which itself is due to the underlying linear depreciation pattern. As the present value of the linear depreciation is well above the corresponding economic depreciation, it is obvious that the real investment is relatively favored by the depreciation pattern. If the depreciation allowance of every period is tax-deductible we receive compound tax savings at $t = 10$ in the same amount.

The highest future value is found for the real investment under German tax law, which in fact is equal to the results found under asymmetric treatment of gains and losses with no loss-offset limitations.[47] This result is due to the chosen cash flow time pattern. The assumed time structure of the cash flows leads to losses per period that do not exceed the basic amount of €1M. Therefore, no minimum taxation arises. The difference between the alternatives decreases[48] to €0.114M but the financial investment remains tax discriminated.

[46] The exact amount is €1,301,963.16.
[47] Asymmetric treatment means that gains cause a tax liability whereas losses are not taxable and can only be carried forward into the next period without limitation.
[48] In comparison to the difference between the future values in case of a complete loss-offset, which is €0.171M.

The smallest future value (for both investments) occurs in Brazil, where at $\alpha = 0.7$ the minimum tax parameter is the highest one. Hence, the result is not surprising as it is driven by the portion of gains that cannot be offset against current losses.

The smallest difference between the future values of both investment alternatives occurs with the Polish concept. Here, the advantage of the depreciation pattern for real investments is reduced by the loss expiration in $t = 5$. Therefore, almost €0.158M in unused loss carry-forward expires whereas in case of the financial investment, all losses can be offset. The loss decline effects run contrary to the depreciation effect, but as it is smaller the real investment stays advantageous.

Due to the "small" Austrian α no corporate minimum taxation emerges. Thus, this concept invokes the second highest future value. Although the accumulated total tax burden after 10 periods is higher under a complete loss offset (€2.79M[49]) than under the loss offset limitation (€2.66M), the future value is higher by €0.11M. This effect is caused by the loss offset limitation in connection with the interest effect (a tax liability arises in $t = 1$). Here, the difference between the two alternatives declines (by €61,000 in comparison to the after-tax difference) as well, and obviously this concept seems to discriminate real investments although the absolute future value of the real investment remains advantageous.

Under the given set of assumptions regarding depreciation, taxation of earned interest and the rules on loss offset restriction we receive a minimum taxation under CAMT. Here, the loss-offset restriction is the only parameter that establishes a minimum taxation. The only principle with an impact is the 10% floor concept, under which 10% of the CAMT tax base is taxed at a 20% rate.[50] Only if corporate alternative minimum tax income exceeds the exemption amount does minimum taxation become effective. Therefore, we find that 6.7% of business income is taxed under the regular income tax rate.[51] Almost the same result occurs as under the German concept,[52] namely that the future values decrease for both investment alternatives in comparison to the complete loss-offset. Moreover, the difference between the two investment forms is the same in both countries.[53]

The general effects on the future values of the diverse concepts are intuitively expected before on the basis of the built set of equations with respect to e.g. the height of α or a loss decline. Therefore, the following consideration focuses on the countries and the alternative investments within a country. In case of domestic investment companies have to consider the tax law of their home state for their domestic income and cannot decide what minimum tax concept to apply.[54] Therefore, it is particularly interesting to compare the influence between the alternatives within a country.

[49] To enable comparability we subtracted the tax refund of the initial loss offset of €0.9M from the paid taxes amounting to €3,688,992 as if the refund were paid in $t_0$.
[50] See page 11 for details of the concept.
[51] This result is true only if under regular taxation the tax base is reduced to zero by subtracting the existing loss carry-forwards from the positive preliminary tax base.
[52] The future value of the American consideration is only €8,300 smaller than the German one.
[53] €0.114M.
[54] The cross-border consideration would include a possible switch between the concepts by investing in another country.

The following table shows the influence of the minimum taxation concepts in comparison to the complete loss offset. The table does not show the explicit influence of the minimum taxation concept only, because the effects of minimum taxation and depreciation are interdependent. However, the numbers indicate how the various concepts affect the future values. We showed above that the difference between the investment alternatives is caused by the depreciation pattern only (in case of the complete loss offset). By comparing the difference between financial and real investment of each concept with the corresponding value of the complete loss offset, we can isolate the effect that is caused by the concepts only. This change in difference is an indicator of the effective direction of the concepts.

Therefore, the second column illustrates the difference between the future value of the financial investment under a loss-offset restriction in the respective country and the future value under complete loss-offset (denoted by $\Delta_1$). We see a corresponding comparison in the third column for real investments ($\Delta_2$). The fourth column describes the relative change between the real and the financial investment ($\Delta_3$) in comparison to the complete loss offset in percentage points. A negative (positive) percentage indicates a(n) decreased (increased) advantage of the real investment. The last column presents these changes in absolute numbers.

| | $\Delta_{1\,FI}$ | $\Delta_{2\,RI}$ | $\Delta_{3\,RI-FI}$ |
|---|---|---|---|
| **Complete l-o** | 100% | 100% | **0%** |
| **asymmetric** | 98.57% | 98.26% | **-0.31%** |
| **Germany** | 98.57% | 98.26% | **-0.31%** |
| **Austria** | 98.28% | 97.96% | **-0.32%** |
| **Brazil** | 96.95% | 96.72% | **-0.24%** |
| **Poland** | 98.57% | 97.88% | **-0.68%** |
| **USA** | 98.52% | 98.21% | **-0.31%** |

$\Delta_{1\,FI}$: $FV_F^I$-$FV_F^c$, $\Delta_{2\,RI}$: $FV_R^I$-$FV_R^c$ and $\Delta_{3\,RI\text{-}FI}$ : $\Delta_{2\,RI}$ - $\Delta_{1\,FI}$

**Table 3:** Difference in the future values for financial and real investments for constant cash flows caused by minimum taxation

An implementation of the German concept affects the future values of both types of investment in the same way as an asymmetric taxation by a tax carry-forward[55] would do (shown by 98.57% in column two and 98.26% in column three). This is because only normal taxation and no minimum taxation arises, because business income does not exceed the base amount.

The negative values in the last column show that in all cases the difference between the future values decreases. This implies that the after-tax advantage of real investments decreases under minimum taxation, too. Therefore, all minimum taxation concept effects run counter to the underlying (paradox) depreciation effect. However, as the effect from minimum taxation is considerably smaller, the real

[55] Under asymmetric taxation losses can only be deducted against positive income, a remaining loss has to be carried forward. For the influence of asymmetric treatment of gains and losses see e.g. Auerbach, A. (1986), Altshuler, R./Auerbach, A. (1990), or Shevlin, T. (1990).

investment still remains advantageous in all cases. The first result we can deduce is that all concepts discriminate real investments more than financial investments.[56]

A first rank order of the different concepts can be given as follows. Under the given set of assumptions the Polish concept exerts the biggest negative impact on real investments in comparison to the financial investment, followed by Austria, Germany, the United States and Brazil. Although the absolute impact of the Brazil concept has a broad negative impact on the future values of both investments, this concept seems to influence real investment alternatives in a less discriminatory manner than the other concepts in this scenario.

## 2.2 INCREASING CASH FLOWS

As the time pattern of the cash flow may have a significant influence on the tax effects we analyze the same scenario for another time structure. We assume an initial positive cash flow in the first year of €370,796 and subsequent cash flow growth of $g = 1.3$. This growth rate and the $CF_0$ were chosen because they lead to the same pre-tax future value as in the previous scenario.

In correspondence with the previous consideration of constant cash flows we focus only on the relation and variation of the future values of the concepts to the future value of a complete loss-offset. For transparency we show our results in the following table in relative values and refrain from absolute numbers.

| | $\Delta_{1\,FI}$ | $\Delta_{2\,RI}$ | $\Delta_{3\,RI-FI}$ |
|---|---|---|---|
| **Complete l-o** | 100% | 100% | **0%** |
| **asymmetric** | 98.57% | 95.96% | **-2.61%** |
| **Germany** | 98.57% | 95.91% | **-2.66%** |
| **Austria** | 98.28% | 95.72% | **-2.56%** |
| **Brazil** | 96.95% | 95.00% | **-1.95%** |
| **Poland** | 98.57% | 88.53% | **-10.04%** |
| **USA** | 98.52% | 95.92% | **-2.60%** |

$\Delta_{1\,FI}$: $FV_F^I$-$FV_F^c$, $\Delta_{2\,RI}$: $FV_R^I$-$FV_R^c$ and $\Delta_{3\,RI-FI}$ : $\Delta_{2\,RI}$ - $\Delta_{1\,FI}$

**Table 4:** Difference of the future values for financial and real investments for increasing cash flows caused by minimum taxation

For increasing cash flows we obtain results that correspond to those for constant cash flows. To isolate the impact of minimum taxation we have to identify the magnitude of the tax effect due to depreciation. The present value of the linear depreciation is well above the respective economic depreciation. The linear depreciation leads to tax savings that which $t = 10$ are €0.916M higher than with economic and thus neutral depreciation. Obviously, real investments are relatively favored by the underlying depreciation pattern (classic tax paradox).

[56] This result is in line with the findings of Niemann, R. (2004c).

Looking at the effects of minimum taxation, the only country where the influence of minimum taxation leads to a relative advantage of the financial investment is Poland. Evoked by the expiration of the remaining loss carry-forward in the fifth period of €3.6M, the following tax bases are taxable in full. In case of the financial investment, higher gains in the first four years lead to a higher loss offset (loss carry-forward expiration = €0.16M).

In this case, applying Polish loss offset rules discriminate real investments more than it does financial investments to a greater extent than every other concept. Even the major advantage of the depreciation pattern vanishes due to the drawback from the loss expiration (see $\Delta_3 = 10.04$ in table 4).

In comparison to the scenario with constant cash flows the differences between the alternatives arose with all concepts caused by the depreciation pattern and the cash flow time structure. As evidenced by the negative values in the last column, we find that all real investments are discriminated.

The future values of the real investments in Germany, Austria, Brazil and USA are greater than in the analysis for constant cash flows. This is because in the first three years negative business income incurs[57] and no taxation arises. In terms of increasing cash flows (under existing assumptions) the German concept shows a difference to asymmetric taxation because a concept-inherent minimum taxation occurs in $t = 7$. As it is only €0.1M, the percentage difference of the values in the third column is similar.

In Austria the corporate minimum tax (CMT) is levied on the profits from the investment as, under the given set of assumptions, the regular tax in the first four years is less than the minimum tax. The CMT credit can be offset partly in the fourth period against regular tax. Since this credit is only a small amount and also deductible from income in the following years, it has only a very small impact on the future value. The overall effect of the CMT and the loss offset limitation leads to a greater negative impact on real investments than it does in case of constant cash flows but a smaller impact than the German, American or Polish concept (-2.56%).

In this consideration, too, the smallest change in percentage points between the differences (-1.95%) occurs in the Brazilian concept, although it has the greatest negative impact on the future values of both investments.

Summarizing the effects, almost the same rank order of discrimination of real investments can be seen as in section 2.1. The Polish concept has the biggest negative impact on real investments in contrast to the financial investment, followed by Germany, the States, Austria and Brazil. Only Germany and the USA changed rank.

[57] The depreciation allowance in these periods is greater than the cash flow.

## 2.3 DECREASING CASH FLOWS

Now, we analyze decreasing cash flows with $CF_1 = €3.3235M$ and a growth rate of $g = -0.3$. Assuming identical pre-tax results for the financial and the real investment we find a relative after-tax advantage for the financial investment. As the present value of the linear depreciation is well below the corresponding discounted economic depreciation (€0.938M), it is obvious that the financial investment is relatively favored by the depreciation pattern. In this scenario the compound tax savings in $t = 10$ in case of economic depreciation lead to a difference of €0.554M between financial and real investment, which leads to the classic tax paradox.

The following table summarizes the results:

| | $\Delta_{1\,FI}$ | $\Delta_{2\,RI}$ | $\Delta_{3\,RI-FI}$ |
|---|---|---|---|
| **Complete l-o** | 100% | 100% | **0%** |
| **asymmetric** | 98.57% | 99.20% | **0.63%** |
| **Germany** | 98.57% | 98.99% | **0.42%** |
| **Austria** | 98.28% | 99.07% | **0.79%** |
| **Brazil** | 96.95% | 97.73% | **0.78%** |
| **Poland** | 98.57% | 99.00% | **0.43%** |
| **USA** | 98.52% | 99.16% | **0.64%** |

$\Delta_{1\,FI}$: $FV_F^I$-$FV_F^c$, $\Delta_{2\,RI}$: $FV_R^I$-$FV_R^c$ and $\Delta_{3\,RI-FI}$ : $\Delta_{2\,RI}$ - $\Delta_{1\,FI}$

**Table 5:** Difference in future values for financial and real investments for decreasing cash flows caused by minimum taxation

Since the difference between the future value of the financial investment and the real investment decreased in all concepts (positive value in the last column), all concepts show a discrimination of financial investments. This effect runs counter to the depreciation effect. It depends on the height of the effects and a case-by-case consideration is necessary to figure the point out, where an advantage of the respective investment changes into a disadvantage.

In this case, the Polish concept does not invoke the biggest distortion. Once more, the effect caused by the concepts runs counter to the depreciation effect. Therefore, the after tax advantage of the financial investment decreases by implementing any of the considered concept. All concepts tend to discriminate financial investments in contrast to real investments with decreasing cash flows.

Here again, the influence of the chosen cash flow stream is obvious. The time structure of the cash flow exerts an important impact on the future values and may be decisive for the rank order of the countries. We can state the following rank order: Austria, Brazil, USA, Poland and Germany. As the values are relatively close together, the influence of the concepts is comparable.

In summary, we see that under the given set of assumptions we receive greater future values by choosing a real investment with constant or increasing cash flows. Decreasing cash flows lead to smaller future values than the alternative financial

investment. But if we consider only the minimum taxation effect we find that financial investments are more likely to be discriminated than real investments with decreasing cash flows. Decreasing cash flows are tax-favored because higher cash flows in the first periods lead to a temporary (early) offset of the loss carry-forward even under minimum taxation. Against this background it is interesting to examine whether general conclusions about a distortional or even paradox impact of minimum taxation can be drawn:

Summarizing the results of the deterministic analysis we can state that in case of constant and increasing cash flows all minimum taxation concepts discriminate real investments whereas financial investments are discriminated in comparison to real investment in case of decreasing cash flows. The biggest distortion occurs in case of increasing cash flows.

As we can isolate the influence of the minimum taxation concepts and find out that the minimum taxation effect runs counter the depreciation effect, we can quantify the effects in relative values. In case of constant cash flows the minimum taxation effect ranges between 27.5% and 33.44%[58] of the depreciation effect. In case of increasing cash flow the effects from minimum taxation are between 42.25% and 54.82%[59] and the effects for decreasing cash flows are between 18.05% and 33.93% of the depreciation effect. Therefore, we conclude it is likely that the depreciation effect is always greater than the minimum taxation effect.

The analyses of the different minimum taxation concepts highlight that the influence on investment decisions can be very severe, and may even be decisive. However, the results are very complex and parameter dependent. To receive more general results on the impact of loss-offset and other minimum tax rules, we have to investigate in more detail the impact of different cash flow time structures. Furthermore, we have to vary our set of assumptions to identify reaction patterns with respect to the most important value drivers. To achieve this, in the following we use a numerical approach, a Monte Carlo Simulation (MCS) assuming a stochastic series of cash flows.

## 3 MONTE CARLO SIMULATION WITH NORMALLY DISTRIBUTED CASH FLOWS

To generalize the above deduced economic results we employ a simulation. In the following analysis the Monte Carlo simulation of a Gaussian function for random cash flows is used to show liquidity and profitability effects of the minimum taxation regulations.[60]

The parameters with a major impact on the investment decision with loss-offset limitations have to be varied by using appropriate distribution parameters. In the

[58] Poland´s value is 72.29%, but as this effect is driven by the loss expiration and not only by the minimum taxation parameter, this result can be disregarded for that conclusion.
[59] Poland´s value is -203.32%. As shown before this is due to the loss carry-forward expiration in t=5. And here too, this result can be disregarded for that conclusion.
[60] Crystal Ball® 2000 and Microsoft Excel® are used.

previous sections we have shown that the cash flow is such a parameter. Because of this, the increment $g_t$ of the cash flows of every year from $t = 2$ to $T$ is assumed to be independent and identically normally distributed with mean μ and variance $\sigma^2$: $\left(CF_t\text{-}CF_{t\text{-}1}\right) = g_t \; \widetilde{iid} \; N(\mu, \sigma^2)$.[61]

Assuming that the drift parameter $\mu = \left\{\begin{matrix}\leq \\ = \\ >\end{matrix}\right\} 0$ the cash flow can either decrease, or remain constant or increase over time.

In line with our first scenario we use the following parameters: $I_0 = €8M$, $D_t = €0.8M$, $L_0 = €3M$, $i = 0.1$, $\tau = 0.3$, $T = 10$, $\mu = 0$ and $\sigma^2 = €0.05M$. We perform a simulation with $\eta = 25{,}000$ trials and, for reasons of comparison, refer to the median of all realizations $CF_1 = €1.301M$ of our forecast variable, the future value of the investment.[62] We assume that[63] as in the deterministic analysis.

As in all considerations the expected value for all cash flows is the same we find again the classical tax paradox as in the deterministic analysis. The relative profitability of the pre-tax future value of the financial investment turns into a relative after-tax profitability of the real investment with respect to the complete loss-offset. This relative discrimination of financial investments remains in all cases with a minimum taxation concept. As the present value of the linear depreciation is above the corresponding value of the economic depreciation we can demonstrate that this effect is caused by the depreciation pattern. Beyond this effect, table 6 shows the impact of the minimum taxation concepts only in terms of the percental deviation from the scenario with complete loss offset. Therefore, the second column illustrates the difference between the future value of the financial investment under a loss-offset restriction in the respective country and the future value under complete loss-offset (denoted by $\Delta_1$). We see a corresponding comparison in the third column for real investments ($\Delta_2$). The fourth column describes the difference of the previous columns, i.e. the relative change between the real and the financial investment ($\Delta_3$) in comparison to the complete loss offset. A negative (positive) value indicates a(n) decreased (increased) advantage of the real investment.

| | $\Delta_{1\,FI}$ | $\Delta_{2\,RI}$ | $\Delta_{3\,RI\text{-}FI}$ |
|---|---|---|---|
| **Complete l-o** | 100% | 100% | **0%** |
| **Germany** | 98.57% | 98.26% | **-0.31%** |
| **Austria** | 98.28% | 97.96% | **-0.32%** |
| **Brazil** | 96.95% | 96.72% | **-0.23%** |
| **Poland** | 98.57% | 97.88% | **-0.69%** |
| **USA** | 98.52% | 98.21% | **-0.31%** |

**Table 6:** Difference of the future values for financial and real investments for normally distributed cash flows with $\mu = 0$ and $\sigma^2 = €0.05M$

[61] Cf. Niemann, R. (2004b), pp. 14.

[62] It can be easily shown that our results are robust for increasing trial numbers. $CF_t$ is calculated on the basis of the assumption that both the real and the financial investment generate the same pre-tax future value. This assumption is in line with our deterministic analyses.

[63] The exact amount is €1,301,963.16. Therefore our first *CF* is deterministic. By using this amount we can compare our results to the deterministic analysis.

Again, we can show that all minimum taxation concepts favor financial investments with constant series of payments (shown by the negative values for $\Delta_3$). The only difference between the simulation and the deterministic analysis is the rank order of the respective concepts' impact. The Polish minimum concept still has the biggest negative impact on real investments in comparison to financial investments, caused by the loss carry-forward expiration in $t = 5$, that is higher in case of real investments. Although the overall impact of the Brazilian concept has the biggest distortional effect on the future values of both investment (lowest future values), the value for $\Delta_3$ is the smallest. Real investments are 0.689% more affected by the minimum taxation concept than financial investments. This amounts to a difference

of €47,085. The Austrian concept is ranked second and here shows a bigger impact than Germany and the States. The difference between the other two concepts (Germany and USA) is very small (0.31% and 0.308%).

Table 7 shows the results of the simulation with $\mu = 0.05M$ for increasing cash flows. Here, too, the result of the deterministic cash flows is confirmed, as the pre-tax profitability of the real investment persists in all concepts. Since the present value of the depreciation is greater than the present value of the economic depreciation, we can reason that the resulting after-tax advantage of the real investment is caused by the depreciation effect. The rank order of the concepts under the given assumptions is: Austria, Poland and Germany, USA and Brazil.

| | $\Delta_{1\ FI}$ | $\Delta_{2\ RI}$ | $\Delta_{3\ RI\text{-}FI}$ |
|---|---|---|---|
| **Complete l-o** | 100% | 100% | **0%** |
| **Germany** | 98.57% | 98.39% | **-0.18%** |
| **Austria** | 98.28% | 98.10% | **-0.19%** |
| **Brazil** | 96.95% | 96.91% | **-0.04%** |
| **Poland** | 98.57% | 98.39% | **-0.18%** |
| **USA** | 98.52% | 98.36% | **-0.16%** |

**Table 7:** Difference of the future values for financial and real investments for normally distributed cash flows with $\mu = 0.05M$ and $\sigma^2 = €0.05M$

Setting the parameter to $\mu = -0.05M$ generates a decreasing series of cash flows, leading to the following table:

| | $\Delta_{1\ FI}$ | $\Delta_{2\ RI}$ | $\Delta_{3\ RI\text{-}FI}$ |
|---|---|---|---|
| **Complete l-o** | 100% | 100% | **0%** |
| **Germany** | 98.57% | 98.11% | **-0.46%** |
| **Austria** | 98.28% | 97.79% | **-0.49%** |
| **Brazil** | 96.95% | 96.50% | **-0.45%** |
| **Poland** | 98.57% | 97.16% | **-1.41%** |
| **USA** | 98.52% | 98.07% | **-0.45%** |

**Table 8:** Difference of the future values for financial and real investments for normally distributed cash flows with $\mu = -0.05M$ and $\sigma^2 = €0.05M$

In case of decreasing cash flows, a different result as in the deterministic analysis is found. The pre-tax advantage of the financial investment persists during a complete loss-offset in an after-tax consideration. The real investment is discriminated by current taxation, as the comparison of the present values of linear and economic depreciation shows. The relative advantage of the financial investment even increases with respect to the future value differences.

In contrast to the deterministic analysis the minimum taxation concepts discriminate real investments in all cases (shown by the negative value in column 4). This result does not contradict the results of our deterministic analysis. Obviously, an asymmetric taxation of gains and losses leads to an asymmetric distribution of the future values in a stochastic environment.[64] Modeling cash flows whose expected value decreases over time we receive more realizations in which real investments are discriminated more than financial investments. We find fewer situations where real investments are favored. Therefore, we receive a different result for random cash flows while referring to the median of the future values.

Summarizing the results, it seems all concepts have the same impact on the investment alternatives, albeit on a different level. To learn more about the effects, we have to analyze the sensitivity of the forecast variable towards the relevant parameters. Therefore, the following section focuses on different parameters.

# 4 SENSITIVITY ANALYSIS

The model used in this paper is restricted by the underlying set of assumptions. The following considerations clarify the consequences of the changes in the model parameters. Before two major assumptions, the amount of the initial outlay $I_0$ and therefore the cash flows $CF_0$ and the initially existing cash flow $L_0$ (loss carry-forward) are analyzed in detail, we refer briefly to the other parameters.

To abstract from the depreciation effect to analyze the effect of minimum taxation only, one could integrate economic and hence neutral depreciation instead of linear depreciation. Comparing financial and real investments, in this analysis we found that no distortional minimum taxation effect occurs at all when we introduce economic depreciation. Setting the pre-tax future values of the investment alternatives equal leads to a tax base that is identical to the tax base in case of financial investment. As the tax bases are equal in the first period, the tax liabilities are identical as well. Therefore, no different liquidity or interest effect emerges and in the following periods we achieve the same tax payment and results for both investment forms. The only effect that emerges is the overall impact of the minimum concepts, namely that the future values decrease in both cases, which is a logical result of an impairment of the taxation framework. Therefore, and because of the interdependency of depreciation and minimum tax, it is necessary to take the depreciation pattern into account to be able to determine the volume and the direction of the minimum taxation effect. First, the volume is a function of the volume of the depreciation effect. The greater the difference of the future values

[64] See Niemann, R. (2004), p. 19.

between the two investment alternatives, the greater the effect caused by the minimum taxation concepts.[65] We also find that the effect due to the minimum taxation concepts runs counter to the depreciation effect under the given assumptions. Hence, a more detailed consideration of diverse depreciation rules could lead to further results. However, as the chosen linear depreciation is the most common and in all considered countries the only allowed depreciation method, no further analysis seems necessary. An increase in the tax rate makes it more likely for real investments with increasing cash flows to be discriminated than financial investments. In case of decreasing cash flows a financial investment is more likely to be discriminated. So we can confirm the results of the deterministic analysis. As we get these discriminatory effects for the concepts for every simulated tax rate, the tax rate does not seem to influence the impact of the concepts materially.[66] The different effects in case of decreasing cash flows are rather caused by the different scenarios of cash flows, initial outlay and initial loss carry-forward. Therefore, no conclusions about the different distortional effects of the respective concepts can be drawn. It is thus worthwhile focusing on varying values of $I_0$, $CF_t$ and $L_0$ in the following.[67]

In case of a complete loss-offset a higher initial loss carry-forward causes an increase in the future value in case of positive cash flows of a successful investment ($CF_t > L_t$) until all cash flows are offset. A further increase of the initial loss carry-forward does not invoke a higher future value as in $t = 10$ remaining losses expire completely and hence have no terminal value.[68] Since the considered minimum taxation concepts are a kind of loss-offset limitation the effect caused by the concepts increases with an increase in the initial given loss carry-forward $L_0$. As shown in the following two figures the values (denoted in percentage points) increase with an increasing $L_0$. The greater the loss carry-forward, the greater the impact of the minimum taxation concept. Therefore, the effect converges towards zero with decreasing $L_0$. As an example of the scenarios with constant cash flows we illustrate the effects on the future values for increasing $L_0$ with an initial outlay of €8M and €60M. For a full overview of all values, see the appendix.

[65] Therefore, considering the deterministic analysis, we have the greatest percental and absolute distortion of the concepts in case of increasing cash flows, where the linear depreciation is €373,547 higher than the economic one. See last column in table 3. The percental values range between 1.95% and 10.04%.

[66] No tax paradox occurs within the analysis in all considered variations of $\pi$.

[67] Another option would be to vary the initial loss carry-forward and the growth rate g. But varying the growth rate means that we would have to change the first cash flow as well, as in our assumptions the pre-tax final values match for real and financial investments. Furthermore, by changing the growth rate we can create scenarios where the increasing cash flows (decreasing cash flows) converge towards the scenario with constant cash flows or where the impact of the cash flows rises. This is not what we want to analyze here as the general impact of these interdependencies has been shown already (see chapter III.2).

[68] This was one of our model assumptions. Integrating a remaining loss offset partially into the terminal value would not change the general result, as can be easily seen by simulation. Against this background we refrained from further analyses on this issue.

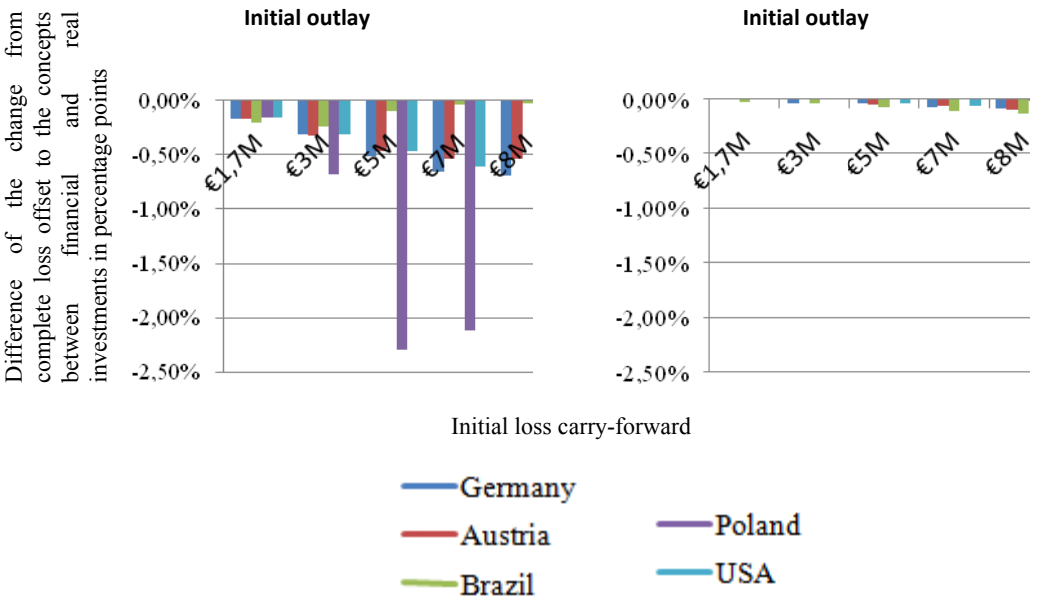


**Figure 1:** Comparison of the difference of financial and real investments in case of increasing for constant cash flows and an initial outlay of €8M and €60M

Varying the initial outlay *ceteris paribus* influences the future values. With an increase in the initial outlay the future value of the financial investment will increase, too, as interest is paid on the basis of the invested funds. To keep the equality of financial and real investment future values the cash flows of the real investment project have to be adjusted correspondingly. An increase in the investment amount while the cash flows are maintained would lead to a higher pre-tax future value of the financial investment. With respect to the real investment, an increasing initial investment leads to higher linear depreciation that exceeds the cash flow in some or even all periods. Then possibly no positive tax base and no taxation occur. However, an increasing initial outlay will often be accompanied by higher expected cash flows. In the end the overall effect depends on the amount and time structure of cash flows and depreciation and the invested funds. The change in the future value of the real investment caused by a variation of is followed by another assumption about how a higher initial outlay leads to increased cash flows. Since the initial outlay and the cash flows are interdependent and only projects with positive cash flows after are considered, we simulate scenarios where the initial outlay and the loss carry-forward increase.[69]

We find that with an increasing and related rising cash flows the difference between financial and real investments in all scenarios decreases and converges towards zero. This effect is illustrated in figure 2. This effect is the same as with decreasing loss carry-forwards, because the difference between losses and gains increases and, in consequence, the impact of the minimum taxation concepts that is

[69] For the complete table see Appendix. If not otherwise stated we assume , , and .

linked to the loss carry-forward decreases. Figure 2 shows the difference between financial and real investments resulting from a complete loss offset to the respective minimum taxation. Here, decreasing cash flows are illustrated exemplarily.[70] Once more we can state that all concepts distort in the same direction as all values are positive. Positive differences imply that financial investments are discriminated. We can also see the differences that arise from the various concepts. Comparing the left with the right figure we can see the impact of an increasing .

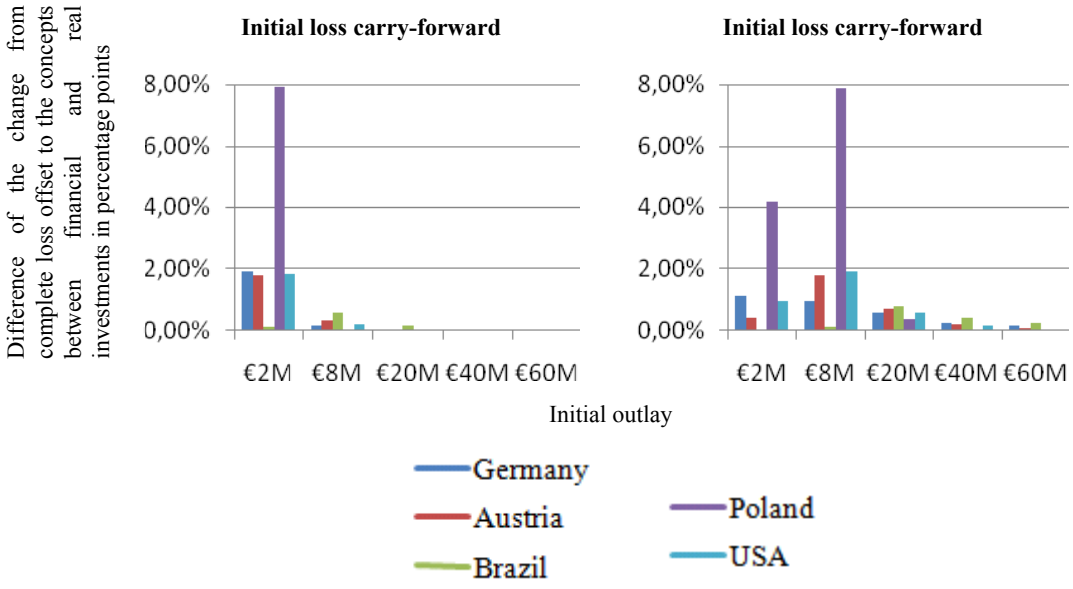


**Figure 2:** Comparison of the difference of financial and real investments in case of increasing for decreasing cash flows and initial loss carry-forward of €1.7M and €7M

In all variations the distortion in case of increasing cash flows is the greatest because lower cash flows in the first few periods cause a later loss carry-forward offset, which in turn causes a greater negative liquidity and interest effect in comparison to constant or decreasing cash flows.[71]

Moreover, we show the same overall minimum taxation effect for all considered concepts. Real investments with increasing or constant cash flows are more likely to be discriminated than financial investments. Furthermore, financial investments are discriminated in contrast to real investments with decreasing cash flows.

In line with former analyses we can confirm that in Germany, minimum taxation arises only for scenarios with high cash flows and a high initial loss carry-forward due to the base amount in the German minimum tax concept.[72] As the German $\alpha$ and $\beta$ are linked to the cash flow as well as to the loss carry-forward the relation between these two values is essential.

[70] See Appendix for the complete table with all variations and cash flow structures.
[71] See Appendix.
[72] See e.g. Niemann, R. (2003, 2004a, 2004b), Dworin, L. (1987) and Auerbach, A. (1986).

The Polish concept has major distortional pote ntial with respect to the future values, as the losses expire in $t = 5$. The Polish $\delta$ causes a minimum taxation in every case, no matter how small or big the carry-forward, whenever the tax base exceeds half the initial loss carry-forward. Since $\delta$ solely influences the loss carry-forward an increasing loss carry-forward leads to a decrease in the difference to the complete loss-offset. This result is also consistent with former studies.

The exemption amount of the US concept affects the future value in the same way as the German base amount. The $\varepsilon$ for the CAMT distorts the investment decision similar to $\alpha$, for the underlying assumptions. With rising cash flows, the Austrian CAMT vanishes since minimum taxation is ensured by the loss-offset limitation of 0.25 of the cash flow.

The Brazilian concept causes the greatest impact on the future values of all considered alternatives. The high loss-offset limit parameter of 0.7 also leads to the biggest distortion in the comparison of real versus financial investments. The relative difference between the investment alternatives is always the greatest.[73]

Having conducted diverse parameter changes during our sensitivity analysis we can draw the following general conclusions:[74]

1. A distortion caused by a minimum taxation rule only occurs in case of additional tax base-influencing effects like the depreciation effect. The effect of the minimum taxation concepts runs counter to the depreciation effect.
2. In case of increasing cash flows the minimum taxation effect is the greatest, as in that scenario the value driving depreciation effect is greater than with decreasing or constant cash flows.
3. With an increasing $I_0$ and related cash flows $CF_t$ the difference between financial and real investments in all scenarios decreases and converges towards zero.[75]
4. With an increase in the initial given loss carry-forward $L_0$ the difference between the alternative investments rises as well.

# IV CONCLUSIONS

In this paper we analyze the impact of various real-world minimum tax concepts on corporate investment decisions. These investments can be realized in the form of either a real or a financial investment. In a quantitative analysis we refer to the future values of the investments as an indicator of tax-favored and tax-discriminated projects. For the first time a set of equations has been deduced to model different minimum tax concepts in a unique and comprehensive model. The generated equations can be used as a basis for further analyses in the field of group taxation, wealth taxation and taxation under uncertainty and allow us to gain some initial

[73] See Appendix.
[74] All these results are limited by the underlying set of assumptions.
[75] See Appendix.

insights with respect to the direction and magnitude of tax distortions of possible competing income-related minimum tax concepts.

Varying the concept-specific loss-offset parameters as well as the cash flow time structure clarifies the impact of the particular minimum taxation concept. Depending on the set of parameters complex tax effects can be identified. For all minimum taxation concepts it can be summarized that real investments with increasing cash flows are more likely to be discriminated against than financial investments or than real investment projects with constant cash flows. Moreover, in contrast to real investments with decreasing cash flows financial investments are more likely to be discriminated by income-related minimum taxation concepts.

Furthermore, we show that in our model the minimum taxation effect only occurs if a depreciation effect exists and moreover, that these two effects influence the after-tax profitability of the real investment project in opposite directions.

The German minimum taxation concept with its base amount seems to have the intended impact only on companies with relatively high incomes and high loss carry-forwards, since the base amount of €1 million plus another 60% has to be exceeded. Besides, it has to be investigated empirically how many companies enjoy a complete loss-offset due to the base amount and how many companies are subject to minimum taxation.[76] The Polish concept with a time-limited loss carry-forward increases the distortional effect on real investments. In particular, a relative discrimination for projects with decreasing cash flows is identified.

In the simplified model, the US CAMT functions as a loss-offset limitation. Under CAMT, there are a vast number of further detailed and complex regulations, e.g. with respect to depreciation, investment credits etc. that determine the CAMT tax base. These details vary greatly from tax payer to tax payer and therefore have not been integrated into our comprehensive model. To analyze their effect the model needs to be extended. Such a complex model will no longer be suitable for comparing the underlying different concepts; rather, it would allow us to deduce single case effects for the US only. As this is beyond the scope of this paper, we fall back on a simplified description of the US minimum tax concept that contains the most important aspects of CAMT. The complexity and poor manageability of the US concept leads to very high compliance costs.

We find similar effects for the Austrian CMT, which only influences small incomes but incurs increased compliance costs.

Since investments, particularly by multinationals, are carried out in different countries the influence of the various minimum tax concepts on cross-border decision making has to be integrated into capital budgeting and tax reform discussions for future research. Against this background, the effects of differences in tax rates, interest rates and depreciation rules on minimum taxation can become crucial to a cross-border investment decision. Thus, our results represent interesting

[76] As Dwenger, N. (2008), p. 21 shows in her paper, only 180 out of 11,243 companies that reported a gross income that exceeds € 1M are subject to minimum taxation (in 2001).

information for corporate investors and also for tax reform discussions. They can be used as a basis for future analyses in this field.

**Sensitivityanalysis**

| Lt / Io | countries\ CF | €1,7M. const. | €1,7M. increas. | €1,7M. decreas. | €3M. const. | €3M. increas. | €3M. decreas. | €5M. const. | €5M. increas. | €5M. decreas. | €7M. const. | €7M. increas. | €7M. decreas. | €8M. const. | €8M. increas. | €8M. decreas. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| €8M. | Germany | -0,17% | -1,91% | 0,16% | -0,31% | -2,66% | 0,42% | -0,51% | -3,43% | 0,77% | -0,66% | -3,85% | 0,93% | -0,69% | -3,95% | 0,95% |
| | Austria | -0,17% | -1,93% | 0,31% | -0,32% | -2,56% | 0,79% | -0,47% | -3,04% | 1,50% | -0,54% | -3,14% | 1,80% | -0,54% | -3,09% | 1,79% |
| | Brazil | -0,20% | -1,81% | 0,55% | -0,24% | -1,95% | 0,78% | -0,09% | -2,08% | 0,28% | -0,04% | -1,73% | 0,11% | -0,02% | -1,57% | 0,04% |
| | Poland | -0,16% | -7,03% | 0,00% | -0,68% | -10,04% | 0,43% | -2,30% | -10,86% | 4,22% | -2,12% | -10,00% | 7,86% | -2,04% | -9,61% | 7,57% |
| | USA | -0,15% | -1,94% | 0,21% | -0,31% | -2,60% | 0,64% | -0,47% | -3,23% | 1,38% | -0,61% | -3,51% | 1,92% | -0,59% | -3,53% | 2,09% |
| €20M. | Germany | -0,02% | -1,14% | 0,02% | -0,07% | -1,54% | 0,14% | -0,11% | -2,04% | 0,33% | -0,16% | -2,40% | 0,55% | -0,21% | -2,55% | 0,63% |
| | Austria | -0,05% | -1,19% | 0,01% | -0,12% | -1,60% | 0,12% | -0,22% | -2,10% | 0,40% | -0,32% | -2,48% | 0,68% | -0,35% | -2,59% | 0,88% |
| | Brazil | -0,07% | -1,31% | 0,13% | -0,14% | -1,63% | 0,34% | -0,21% | -1,88% | 0,66% | -0,23% | -1,96% | 0,79% | -0,23% | -2,03% | 0,77% |
| | Poland | 0,00% | -0,01% | 0,00% | -0,04% | -5,64% | 0,00% | -0,18% | -7,77% | 0,08% | -0,29% | -9,62% | 0,34% | -1,18% | -10,45% | 0,52% |
| | USA | -0,04% | -0,01% | 0,00% | -0,08% | -1,57% | 0,09% | -0,19% | -2,11% | 0,34% | -0,28% | -2,51% | 0,59% | -0,34% | -2,69% | 0,73% |
| €40M. | Germany | 0,00% | -0,87% | 0,00% | -0,02% | -1,11% | 0,03% | -0,07% | -1,41% | 0,13% | -0,12% | -1,70% | 0,23% | -0,11% | -1,80% | 0,30% |
| | Austria | 0,00% | -0,86% | 0,00% | -0,05% | -1,12% | 0,00% | -0,08% | -1,44% | 0,08% | -0,12% | -1,72% | 0,19% | -0,16% | -1,83% | 0,27% |
| | Brazil | -0,02% | -1,03% | 0,02% | -0,06% | -1,25% | 0,10% | -0,12% | -1,52% | 0,24% | -0,17% | -1,72% | 0,42% | -0,18% | -1,78% | 0,52% |
| | Poland | 0,00% | -3,12% | 0,00% | 0,00% | -3,89% | -0,01% | 0,00% | -5,07% | 0,00% | -0,09% | -6,21% | 0,00% | -0,15% | -6,77% | 0,00% |
| | USA | 0,00% | -0,92% | 0,00% | -0,03% | -1,13% | -0,01% | -0,06% | -1,44% | 0,05% | -0,12% | -1,74% | 0,13% | -0,16% | -1,89% | 0,17% |
| €60M. | Germany | 0,00% | -0,79% | 0,00% | -0,03% | -0,97% | 0,00% | -0,04% | -1,18% | 0,05% | -0,07% | -1,39% | 0,13% | -0,08% | -1,49% | 0,18% |
| | Austria | 0,00% | -0,76% | 0,00% | 0,00% | -0,92% | 0,00% | -0,05% | -1,17% | 0,01% | -0,06% | -1,38% | 0,07% | -0,09% | -1,49% | 0,09% |
| | Brazil | -0,02% | -0,91% | 0,00% | -0,03% | -1,08% | 0,03% | -0,07% | -1,30% | 0,12% | -0,11% | -1,48% | 0,22% | -0,13% | -1,56% | 0,27% |
| | Poland | 0,00% | -2,93% | 0,00% | 0,00% | -3,29% | -0,01% | 0,00% | -4,09% | 0,00% | 0,00% | -4,87% | 0,00% | -0,01% | -5,26% | 0,00% |
| | USA | 0,00% | -0,82% | 0,00% | 0,00% | -0,97% | 0,00% | -0,04% | -1,19% | 0,00% | -0,06% | -1,39% | 0,03% | -0,06% | -1,49% | 0,06% |

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**Impressum:**

**Arbeitskreis Quantitative Steuerlehre, arqus, e.V.**

Vorstand: Prof. Dr. Jochen Hundsdoerfer,
Prof. Dr. Dirk Kiesewetter, Prof. Dr. Caren Sureth

Sitz des Vereins: Berlin

Herausgeber: Kay Blaufus, Jochen Hundsdoerfer, Dirk Kiesewetter, Deborah Knirsch, Rolf J. König, Lutz Kruschwitz, Andreas Löffler, Ralf Maiterth, Heiko Müller, Rainer Niemann, Caren Sureth, Corinna Treisch

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ISSN 1861-8944