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Corporate marginal tax rate, tax loss carryforwards and investment functions – empirical analysis using a large German panel data set

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Abstract

This study is the first empirical analysis to investigate the relationship between the investment behaviour of firms resident in Germany and the empirically determined marginal tax rates developed by John R. Graham. It is based on the Bundesbank's corporate balance sheet statistics for the period 1971-2002. In an autoregressive distributed lag model, the marginal tax rate is shown to be significant, with an elasticity of between 0.1 and 0.2. An error correction model does not produce any plausible results for the marginal tax rate. Graham's marginal tax rates are a complement to the methods typically used to determine the effective marginal tax rates and effective average tax rates.

Keywords: Corporate marginal tax rate, tax loss carryforward, investment behaviour

JEL classification: D 21, H 25

Non-technical summary

Over the past two decades, the relationship between corporate investment behaviour and taxation has become increasingly central to economic and tax policy and therefore also a focus of empirical research. Against the backdrop of economic globalisation and the associated increase in capital mobility, corporate taxation levels have become one of the ways for governments to compete with one another to attract investment and thereby create jobs. As a result of this competition, most industrialised countries have cut corporate tax rates, in some cases by a large margin. These reductions are often financed by broadening the assessment basis, with limitations in tax write-offs and offsetting of losses at the top of the agenda.

The extent to which investment behaviour reacts to changes in this framework is the subject of empirical research, which seeks to identify the determinants of corporate investment. In the empirical literature, the effective marginal tax rate (EMTR) and effective average tax rate (EATR) proved the most suitable methods for analysing investment behaviour. One feature of these methods is the assumption that firms earn a profit. The possibility of making a loss (and the resulting effective marginal tax rate of zero) is typically disregarded. This is not without problems as most firms in Germany show temporary losses. One notable exception is the simulated marginal tax rate method developed by John R. Graham, which allows profitability to be explicitly modelled. This approach makes a point of taking tax loss offsetting into account making it suitable for analysing tax reform measures.

This study is the first empirical analysis of the relationship between the investment behaviour of firms resident in Germany and Graham's empirically developed marginal tax rates. The empirical analysis I conducted was based on the most comprehensive set of German annual financial statements available to researchers: the Bundesbank's corporate balance sheet statistics. The study analysed more than 100,000 firms during the 1971-2002 observation period.

The multivariate analysis showed that using the marginal tax rate in the reduced form (ADL) model produced plausible results. The estimated elasticity level is between 0.1

and 0.2. Therefore, a 10% cut in the marginal tax rate would entail an average increase of one to two percent in the propensity to invest. By contrast, using the marginal tax rate in an error correction model failed to produce any plausible results. In summary, the method should be viewed as an additional source of information as part of an empirical analysis; it certainly has its place alongside the more well-known methods used for calculating effective marginal tax rates (EMTR) and effective average tax rates (EATR).

Nicht technische Zusammenfassung

Der Zusammenhang zwischen dem unternehmerischen Investitionsverhalten und der Besteuerung ist in den vergangenen zwei Jahrzehnten zunehmend in den Mittelpunkt der Wirtschafts- und Steuerpolitik und damit auch der empirischen Forschung geraten. Vor dem Hintergrund der Globalisierung der Weltwirtschaft und der damit verbundenen gestiegenen Mobilität des Faktors Kapital sind die Unternehmenssteuern eines der staatlichen Wettbewerbsinstrumente in der Konkurrenz um den Standort für Investitionen und der damit verbundenen Beschäftigung. In Folge dieses Wettbewerbs wurden in den meisten Industrieländern dîe tariflichen Steuersätze zum Teil sehr deutlich gesenkt. Die Finanzierung dieser Reduzierungen erfolgte in der Regel durch eine Verbreiterung der Bemessungsgrundlage. Hier stehen vor allem Einschränkungen in der steuerlichen Abschreibungs- und Verlustverrechnung zur Debatte.

Inwieweit das Investitionsverhalten auf diese veränderten Rahmenbedingungen reagiert, ist Gegenstand der empirischen Forschung, die versucht Faktoren zu identifizieren, die das unternehmerische Investitionsverhalten determinieren. In der empirischen Literatur haben sich vor allem die Methode des effektiven marginalen Steuersatzes (EMTR) und des effektiven Durchschnittssteuersatzes (EATR) als geeignete Instrumentarien zur Analyse dieser Frage erwiesen. Ein wesentliches Kennzeichnen dieser Methoden ist die Annahme, dass Unternehmen ständig einen Gewinn aufweisen. Die Möglichkeit eines Verlustes und dem damit verbundenen effektiven marginalen Steuersatzes von Null bleibt typischerweise unberücksichtigt. Dies ist nicht unproblematisch, da etwa in Deutschland die Mehrzahl der Unternehmen zeitweilige Verluste ausweisen. Eine Ausnahme ist die von Graham entwickelte Methode der simulierten marginalen Steuersätze, die eine explizite Modellierung und Berücksichtigung der Ertragssituation vorsieht. Im Rahmen dieses Ansatzes wird die steuerliche Verlustverrechnung explizit berücksichtigt. Dieser Ansatz kann damit insbesondere als ein geeignetes Instrumentarium zur Analyse von Steuerreformmaßnahmen dienen, bei denen entsprechende Änderungen eine Rolle spielen.

Die vorliegende Arbeit ist die erste empirische Analyse, die den Zusammenhang zwischen dem Investitionsverhalten von in Deutschland ansässigen Unternehmen und den von Graham entwickelten, empirisch bestimmten marginalen Steuersätzen untersucht. Die durchgeführte empirische Analyse basiert auf dem umfangreichsten Jahresabschlussdatensatz für Deutschland, der zu wissenschaftlichen Zwecken genutzt werden kann. Unter Verwendung der Unternehmensbilanzstatistik der Deutschen Bundesbank wurden über 100.000 Unternehmen im Beobachtungszeitraum von 1971 bis 2002 untersucht.

Im Rahmen der multivariaten Analyse zeigt sich, dass der marginale Steuersatz nach Graham in dem Reduzierte-Form-Modell (ADL-Modell) der Investitionsfunktion zu plausiblen Ergebnissen führt. Die geschätzte Elastizität liegt betragsmäßig zwischen 0.1 und 0.2. Eine Reduzierung des marginalen Steuersatzes um 10% würde demnach mit einer durchschnittlichen Erhöhung der Investitionsneigung von 1 bis 2 Prozent verbunden sein. Die Verwendung dieser marginalen Steuersätze in einem Fehlerkorrekturmodell führt hingegen zu keinen plausiblen Ergebnissen. Zusammenfassend kann festgehalten werden, dass die Methode von Graham als eine zusätzliche Informationsquelle im Rahmen von empirischen Analysen anzusehen ist, die neben den bekannten Methoden der effektiven marginalen Steuersätzen (EMTR) und effektiven Durchschnittssteuersätzen (EATR) durchaus eine Berechtigung besitzt.

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1 Introduction

Over the past two decades, the relationship between corporate investment behaviour and taxation has become increasingly central to economic and tax policy and therefore also a focus of empirical research. Against the backdrop of economic globalisation and the associated increase in capital mobility, corporate taxation have become one way for governments to compete with one another to attract investment and thereby create jobs. As a result of this competition, most industrialised countries have cut corporate tax rates, in some cases by a large margin. These reductions are generally financed by broadening of the tax base, with limitations in depreciation allowances and offsetting of tax losses at the top of the agenda.

The extent to which investment behaviour reacts to changes in this framework is the subject of empirical research, which seeks to identify determinants of corporate investment. Devereux (2003), Devereux, Griffith and Klemm (2002) and Devereux and Griffith (2003) provide a comprehensive summary of the various aspects of taxation (especially tax reforms). In the empirical literature, the effective marginal tax rate (EMTR) and effective average tax rate (EATR) proved the most suitable methods for analysing investment behaviour. One feature that distinguishes these methods is the assumption that firms turn a profit. The possibility of making a loss (and the resulting effective marginal tax rate of zero) is typically disregarded. One notable exception is the simulated marginal tax rate method developed by John R. Graham, which allows profitability to be explicitly modelled (Graham and Lemmon, 1998). Their approach explicitly accounts for tax loss offsetting, making it suitable for analysing tax reform measures.

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This paper will, for the first time, apply the simulated marginal tax rate method to data from firms resident in Germany. The data are obtained from the Bundesbank's corporate balance sheet statistics, which is one of the largest set of data available for research purposes in Germany. Subsequently, the suitability of this rate will be tested using empirical investment models. The principal conclusion of this analysis is that the simulated marginal tax rate method represents a complementary technique for determining the effects of taxation on investment behaviour.

2 Theoretical background

This section provides a description of two investment models widely used in the empirical literature. There then follows a description of the Graham approach to calculating simulated marginal tax rates.

2.1 Empirical investment functions

In the empirical literature in recent years, two models have proved to be particularly suited to estimating investment functions. These are the Autoregressive-Distributed-Lag (ADL) model and the Error-Correction-Model (ECM). Bond and Van Reenen (2003) provide a summary of the derivation and functions as well as selected results.

According to the Bond and Van Reenen (2003) approach, the desired long-run level of the optimal capital stock should be specified as a log-linear function of output and the user cost of capital. k_{it}^* is the logarithm of the capital stock of a firm i in period t, y_{it} the log of output and j_{it} the log of the user cost of capital. This gives the following function:

$$k_{it}^* = c + y_{i,t} - \sigma \cdot j_{i,t} \tag{1}$$

Assuming no adjustment costs, it returns the optimal capital stock for a profit-maximising firm with a CES production function and constant returns to scale. To derive an investment equation which can be estimated (k_{it}^* is unobservable), the static model is first-differenced using the following approximation, where I_t are investments and δ the depreciation rate:

$$\left(\frac{I_t}{K_{t-1}}\right)-\delta \approx \Delta k_{i,t} = \Delta k^{*}_{i,t} \tag{2}$$

where k_{it} is the observable capital stock.

Since the transition from the current to the optimal capital stock is not fully completed in the current period, lag structures (distributed lags) of the type Δk^{*}_{t-s} or Δk_{t-s} are incorporated to allow for this. This results in a dynamic specification:

$$a(L)\Delta k_{i,t} = b(L)\Delta k^{*}_{i,t} \tag{3}$$

The capital stock for the current period t represents preceding periods (t-s), where a(L) and b(L) are polynomials of the lag operators. Taking into account (1) and (3), the generalised estimation equation for an ADL-Model is

$$\frac{I_{i,t}}{K_{i,t-1}} = \delta_i + \sum_{h=0}^{H}\alpha_h\left(\Delta j_{i,t-h}\right) + \sum_{h=0}^{H}\beta_h\left(\Delta y_{i,t-h}\right) + \varepsilon_{i,t} \tag{4}$$

In most empirical studies, this approach is extended by incorporating cash flow terms. These act as measures of liquidity and enable the model to take adequate account of access to financial resources.

$$\begin{aligned}\frac{I_{i,t}}{K_{i,t-1}} &= \delta_i + \sum_{h=0}^{H}\alpha_h\left(\Delta j_{i,t-h}\right) + \sum_{h=0}^{H}\beta_h\left(\Delta y_{i,t-h}\right)\\ &\quad + \sum_{h=0}^{H}\gamma_h\left(\frac{CF_{i,t-h}}{K_{i,t-h-1}}\right) + \varepsilon_{i,t}\end{aligned} \tag{5}$$

An Error-Correction-Model (ECM) offers an alternative to the ADL approach, but is also derived from equation (1). In fact, the ECM is nothing more than a particular parametrization of an ADL-model. The difference is a partial adjustment process for the optimal capital stock. The gap between the desired and optimal capital stock is filled by a constant parameter θ.

$$\left(\frac{I_t}{K_{t-1}}\right) - \delta \approx \Delta k_{i,t} = \theta\left(k_{i,t}^{*} - k_{i,t-1}\right) \tag{6}$$

Assuming an ADL (2,2) model, suitable reparametrisation (Bean (1981)), use of the approximation (2) and the inclusion of cash flow terms gives the following error correction model.

$$\begin{aligned}\Delta k_{i,t} &= \alpha_0 + (\alpha_1 - 1)\cdot \Delta k_{i,t-1} + \beta_0 \cdot \Delta y_{i,t} + (\beta_0 + \beta_1)\cdot \Delta y_{i,t-1} \\ &+ \gamma_0 \cdot \Delta j_{i,t} + (\gamma_0 + \gamma_1)\cdot \Delta j_{i,t-1} - (1 - \alpha_1 - \alpha_2)\cdot [k - y]_{i,t-2} \\ &+ [\beta_0 + \beta_1 + \beta_2 - (1 - \alpha_1 - \alpha_2)]\cdot y_{i,t-2} \\ &+ (\gamma_0 + \gamma_1 + \gamma_2)\cdot j_{i,t-2} + \varepsilon_{i,t}\end{aligned} \tag{7}$$

The corresponding empirical estimation function is

$$\begin{aligned}\left(\frac{I_{i,t}}{K_{i,t-1}}\right) &= \mu_t + \rho_1 \cdot \left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \varpi_0 \cdot \Delta y_{i,t} + \varpi_1 \cdot \Delta y_{i,t-1} \\ &+ \vartheta_0 \cdot \Delta j_{i,t} + \vartheta_1 \cdot \Delta j_{i,t-1} + \theta \cdot (k - y)_{i,t-2} \\ &+ \phi \cdot y_{i,t-2} + \varphi \cdot j_{i,t-2} \\ &+ \psi_0 \cdot \left(\frac{CF_{i,t}}{K_{i,t-1}}\right) + +\psi_1 \cdot \left(\frac{CF_{i,t-1}}{K_{i,t-2}}\right) + \eta_i + \varepsilon_{i,t}\end{aligned} \tag{8}$$

with the unobserved firm-specific effect η_i. Under these modelling conditions, $\theta < 0$ is consistent with error correction in the sense that realised capital stock exceeding the desired level is coupled with lower future investment.

The aim of this study is not to determine the elasticities for the user cost of capital.[1] Instead, it seeks to test the suitability of the approach for measuring marginal tax rates developed by Graham (1996a, 1996b). From this point forward, this study shall assume that all effects incorporated in the user cost of capital besides the tax rate and offsetting of losses (including, *inter alia*, the tax system, depreciation allowances and

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[1] See, *inter alia*, the studies by Chirinko, Fazzari and Meyer (1999) and Harhoff and Ramb (2001).

interest rates) are identical for all firms and can therefore be represented by time dummies in the empirical analysis. Hence, the simulated marginal tax rates are the sole cause of firm-specific variation. Given that cuts in the tax rate are frequently associated with a deterioration in methods of offsetting depreciation allowances, this will be helpful when interpreting the estimated parameters later.

2.2 Simulating corporate marginal tax rates

In most industrialised countries, the past two decades were marked by corporate tax reform. The average tax rate has fallen from 48% at the start of the 1980s to 35% by the end of the 1990s. One-third of EU member states have brought their statutory tax rate below 30% during the last 10 years. The lower tax rates were frequently funded by broadening the tax base. Generally, depreciation allowances have become less generous.[2] However, the restrictions imposed on methods of offsetting loss were virtually disregarded.

A hallmark of most methods used to quantify tax reform measures is their assumption that the firms are profitable. Determining the various procedures for quantifying the tax burden presupposes that the firms turn a taxable profit. These methods generally disregard the fact that, for firms making a loss or those where tax loss carryforwards exceed taxable revenue, the model depend on loss carryforward.[3] Graham (1996a, 1996b) addressed this issue and developed a method that explicitly takes tax loss offsetting into account. It is known as the simulated marginal tax rate. There now follows a brief summary of his method.

Calculating the simulated marginal tax rate requires a model of future income. This is obtained from a statistical forecast of the future tax assessment basis, where taxable income (TI) follows a random walk.[4] In line with expectations, TI is defined as the sum of TI_{t-1} and a random innovation ε_t at time t.[5]

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[2] See Devereux, Griffith and Klemm (2002), Devereux and Griffith (2003) and also Gordon, Kalambokidis and Slemrod (2004) for a summary of how to quantify tax reform measures.

[3] The Devereux (1989) study is an exception.

[4] As well as the simplified assumption of a random walk used here, other factors affecting future income can also be identified, such as indebtedness and the likelihood of insolvency. For simplicity, I have chosen to omit them here.

[5] For a precise description of the technique using an example, see Graham and Lemmon (1998) and Shelvin (1990).

$$TI_t = TI_{t-1} + \varepsilon_t \quad (9)$$

The random innovation ε_t is found from a normal distribution with a mean calculated from the historical rate of revenue growth and a standard deviation based on the deviation in historical revenue. Based on these assumptions, estimates are calculated over the period TI_{t+1} to TI_{t+n}, where n denotes the maximum permitted period for tax loss carryforwards. The net present value of the firms' tax liabilities is determined based on the historical TI from $t-1$ and $t-2$ as well as the forecasts for the following 20 periods[6] ($t+1$ to $t+20$). In a second stage, the net present value of the firms' tax liabilities is recalculated based on the same information from $t-2$ to $t+20$ except that, this time, one euro is added to each TI in t. The net present value of the firms' tax liabilities with the added euro corresponds to the marginal tax rate at time t.

The innovation ε_t denotes the level of uncertainty for the future TI. To ensure that both positive and negative income shocks are possible, the marginal tax rate simulation is repeated 50 times.[7] The arithmetic mean of all the simulation results incorporates a possible spectrum of future environmental conditions (distributions). Using this method, the income and marginal tax rates are usually identical for firms which are profitable throughout the period covered by the analysis. However, it is a different story for firms making a loss: their marginal tax rate is lower than the corresponding income tax rate. Among other factors, this is attributable to the estimations of future TI which, depending on past distributions, might be negative for some firms.

In accordance with the procedure described here, the simulated marginal tax rates were calculated for a data set of firms resident in Germany. The descriptive results and the suitability of these rates for empirical investment functions are discussed below.

[6] Empirical models typically use a forecast for a 20-year period.

[7] The simulation may be repeated infinitely. However, empirical analysis shows that more frequent simulations do not yield any major changes in the average marginal tax rate.

3 Data, the tax framework and descriptive evidence

In the empirical analysis, particular attention must be paid to the construction of, and assumptions made for, the measure of the tax burden described above. First, the data set must include a sufficient number of firms with tax loss carryforwards. Second, estimating plausible regression coefficients presupposes that the tax framework for the offsetting of losses ought to change during the observation period. Third, a meaningful estimate of a firm's future earnings requires a sufficiently large number of observations. These points impose greater requirements on any potential data set. For Germany, only the Bundesbank's corporate balance sheet statistics make the grade.

3.1 Bundesbank's corporate balance sheet statistics

This study is based on the Bundesbank's corporate balance sheet statistics. From 1964 to 1998, the Bundesbank collected financial statements via its branches for non-financial corporations in Germany in connection with its rediscount business. Overall, the statistics comprise approximately 70,000 financial statements from households and corporations for each year over this period.[8] Since the beginning of monetary union in 1999, the Bundesbank has collected financial statements in connection with an analysis of the creditworthiness of eligible assets. This duty is laid down in Article 18.1 of the Statute of the European System of Central Banks, whereby national central banks must ensure that lending is based on adequate collateral. However, owing to these more stringent credit rating requirements, the number of financial statements fell from 36,000 in 1999 to around 21,000 in 2003.[9] This significant decline in the sample size reduced the analytical potential of the microdata set. In particular, selection bias is likely to have occurred, as the sample tends to include larger firms and those with a high credit rating.[10] A panel data set for the 1971-2002 period is currently available for research purposes.[11]

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[8] A complete account of the statistics including the methodology can be found in Deutsche Bundesbank (1998) and Stöss (2001).

[9] For details of the methodology, see Deutsche Bundesbank (2004).

[10] An analysis of small and medium-sized firms using this data was conducted in Deutsche Bundesbank (2003). The problem of selection bias was one reason why a new micro data set was created; see Deutsche Bundesbank (2005).

[11] This data set may be used by German and foreign researchers (for research purposes) subject to certain conditions.

3.2 Underlying tax conditions for loss offsetting

The empirical analysis is focused on corporations resident in Germany. The tax framework in Germany for the relevant taxes (corporation tax on retained and distributed profits, solidarity surcharge, average trade tax collection multipliers) and the provisions related to the offsetting of losses will be discussed here. Between 1971 and 2002 (the period under review), there were two changes to the German tax system. A classical tax system following the US model with a split rate of corporation tax, with double taxation at shareholder level, was in effect between the end of World War II and 1976. From 1977 to 2000, a full imputation system with a split rate of corporation tax was in place, which meant no double taxation. A classical tax system, which uses a shareholder relief system to reduce the level of double taxation at shareholder level, was reinstated in 2001.

Table 1 shows the change in corporation tax rates and the solidarity surcharge over time. The early 1990s brought frequent tax reforms, which were characterised by a marked decline in the rate of corporation tax and, with the introduction of the solidarity surcharge, also synonymous with an additional tax burden on firms. The increase in the average trade tax collection multiplier began to slow in the early 1990s and actually reversed from 2000 onwards.

Table 1. Development of tax rates in Germany

	Corporation tax retained profits	Corporation tax distributed profits	Solidarity surcharge	Average trade tax collection multiplier
1970 1976	51%	15%	/	283 to 319
1977-1989	56%	36%	/	322 to 362
1990	50%	36%	/	364
1991-1992	50%	36%	3.75%	363 to 370
1993-1994	50%	36%	/	371-372
1995-1997	45%	30%	7.5%	373-387
1998	45%	30%	5.5%	390
1999-2000	40%	30%	5.5%	389
2001-2002	25%	25%	5.5%	385 to 386
2003	26.5%	26.5%	5.5%	387
2004-2006	25%	25%	5.5%	387

Sources: Federal Finance Ministry for corporation tax rates and solidarity surcharge. Federal Statistical Office for the average trade tax collection multiplier.

The process of tax loss carryback is regulated in section 10(d) of the Income Tax Act (*Einkommensteuergesetz*). The legal basis for the inter-temporal deduction of losses is the principle of fairness in the tax system and, especially, that of taxing financial performance (Homburg, 2005). Offsetting tax losses can be broadly split into four components: the duration and volume of the carryforward and the duration and volume of the carryback. The legal provisions governing these components were tightened in the period under review. Table 2 provides a summary of events. The rules on loss carrybacks have been toughened considerably, especially since 2000. By contrast, carryforward options have only been restricted since the start of 2004. The primary aim of the regulations in place since then has been to prevent firms from reducing the tax burden on their pre-tax profit to zero by deducting losses carried forward.

Table 2. Tax offsetting in Germany

	Carryback period	Carryback volume
1970-1975	Not permitted	0
1976-1983	1 year	DM 5 million
1984-1999	2 years	DM 10 million
2000	1 year	€2 million
2001-present	1 year	€1 million

	Carryforward period	Carryforward volume
1970 – 1983	5 years	Unlimited
1984 – 2003	Unlimited	Unlimited
2004-present	Unlimited	Unlimited (max. 60% of taxable income may be offset)

3.3 Descriptive evidence

The first step of the descriptive analysis will look at selected variables to describe the data set used. The data was first constrained to ensure conformity with the applicable conditions. The empirical analysis only uses data from corporations for which at least three consecutive observations are available during the period under review and which are outside the financial or public sector. The reason the data is restricted to corporations is that the corporate balance sheet statistics do not give details about the owners, which are required for calculating the tax burden. Public sector and financial corporations are omitted because both groups are under-represented (banks and insurance companies are entirely absent, for instance) and because different rules typically apply for determining the tax base.

Table 3. Descriptive statistics

	Mean	Standard deviation	Lower 10th percentile	Median	Upper 10th percentile
Employees					
1980	346	4,315	6	40	330
1990	361	4,686	6	40	355
2000	544	6,614	6	53	569
Total assets					
1980	35	434	0	3	24
1990	41	573	1	3	30
2000	143	2256	1	6	115
Turnover					
1980	49	522	1	5	43
1990	54	634	1	6	50
2000	131	1696	1	10	119
Cash flow					
1980	2.33	32.38	0.00	0.18	2.02
1990	3.40	56.59	0.00	0.20	2.79
2000	12.02	254.28	0.00	0.35	7.98
Pre-tax profit					
1980	2	30	0	0	1
1990	2	33	0	0	2
2000	8	166	0	0	6
Loss carried forward					
1980	2.07	24.69	2.35	0.11	0.01
1990	1.53	16.02	1.77	0.10	0.01
2000	8.67	68.17	10.13	0.31	0.01
Dividends					
1980	1.93	14.96	0.01	0.12	1.85
1990	2.48	19.90	0.01	0.14	2.30
2000	13.88	132.40	0.03	0.42	11.30
Capital ratio					
1980	0.18	0.17	0.03	0.13	0.39
1990	0.16	0.18	0.01	0.11	0.37
2000	0.21	0.21	0.02	0.15	0.49

All values were deflated using the GDP price index (base year: 1995). Figures for balance sheet total, turnover, cash flow, pre-tax profit, loss carried forward and dividends are in millions. Statistical calculations of firms' dividends and losses carried forward only where applicable. The deflated variables are also used in the multivariate analysis.

Table 3 gives an indication of the structure and quality of the data used. The statistics on the number of employees, the total asses and turnover show that small, medium-sized and large enterprises are represented in the data set. They also show that, on average, the firms expanded between 1980 and 1990. The rise in the indicators for the year 2000 is attributable to the change in the data collection method discussed in section 3.1. Hence, a robustness check is required in the multivariate analysis for the period post-1997 to detect potential selection bias towards large and successful corporations. Furthermore, table 3 indicates that more than 10% of the corporations made a pre-tax profit. A sharp rise in tax loss carryforwards can be detected from 2000 onwards. This may be due to selection bias. On the other hand, the rise can also be explained by the special effects that occurred in 2000, which represented the final opportunity to offset disposal losses from equity holdings against tax. A closer analysis of a sample which is included in the data set throughout the period under review (balanced panel) supports the latter explanation.

Table 4 shows a breakdown of firms by size. The categories used are as defined by the EU (European Commission, 2003). Small enterprises are defined as having fewer than 50 employees and turnover not exceeding €10 million or fewer than 50 employees and an annual total assets not exceeding €10 million. Medium-sized enterprises have between 50 and 250 employees and turnover of between €10 million and €50 million or between 50 and 250 employees and a total assets of between €10 million and €43 million. Table 4 illustrates that all size categories were adequately represented. The proportion of small enterprises remained constant between 1980 and 1990. Over the same period, the share of medium-sized enterprises increased. Since the change in methodology, however, the share of small enterprises has fallen considerably. This has a detrimental effect on the representativeness of the sample and will be taken into account at subsequent stages of the empirical analysis. Furthermore, it should be noted that the overall sample is characterised by a large number of entry and exits throughout the panel. For example, the total number of small enterprises that were part of the sample during the observation period amounted to around 95,000.

Table 4. Number of firms and observations by size

	Small enterprises	Medium-sized enterprises	Large enterprises
1980	25,066 (62.32%)	3,219 (8.00%)	11,934 (29.67%)
1990	29,054 (62.28%)	6,243 (13.38%)	11,350 (24.33%)
2000	12,313 (48.72%)	5,545 (21.94%)	7,416 (29.34%)
1971-2002	95,088	22,428	43,166

It is crucial for the purposes of this study that the sample includes a sufficient number of firms with losses and tax loss carryforwards. Table 5 indicates the number of observations, the number of firms and the respective percentage share of firms with a negative pre-tax result, arranged by size. Overall, around two-thirds of the small enterprises (61,000 out of 95,000) made a pre-tax loss in the period under review. Approximately one-third of these firms reported a negative pre-tax result for only one year. As much as 17 per cent of small enterprises reported a negative result in five or more years. In terms of the frequency with which they post losses, medium-sized and large enterprises are very similar. Just under 25 per cent made a loss in only one year. At over 25 per cent, the share of firms posting a loss in more than four years is notably higher than for small enterprises.

Table 5. Number of periods with a negative pre-tax result (1971 to 2002)

	Small enterprises		Medium-sized enterprises		Large enterprises	
	Obs.	Firms	Obs.	Firms	Obs.	Firms
1	124,267 (26.08%)	19,697 (31.81%)	21,817 (21.09%)	3,769 (23.85%)	48,201 (19.99%)	7,573 (24.95%)
2	100,207 (21.03%)	14,803 (23.91%)	19,569 (18.91%)	3,278 (20.74%)	41,035 (17.02%)	6,242 (20.56%)
3	76,646 (16.08%)	10,294 (16.63%)	16,131 (15.59%)	2,560 (16.20%)	36,240 (15.03%)	4,950 (16.31%)
4	56,546 (11.87%)	6,377 (10.30%)	12,396 (11.98%)	1,909 (12.08%)	30,107 (12.49%)	3,591 (11.83%)
≥5	118,845 (24.94%)	10,745 (17.35%)	33,558 (32.43%)	4,290 (27.14%)	85,549 (35.48%)	7,999 (26.35%)
Total	476,511	61,916	103,471	15,806	241,132	30,355

Losses from preceding periods – known as loss carryforwards – are also relevant when assessing a firm's pre-tax result (see table 6).[12] Approximately one-third of all firms (regardless of size) have carried a loss forward at least once during the period under review. Although the figures reveal no difference between the groups for firms with a loss carryforward in one year, medium-sized and large enterprises are far more likely to have carried a loss forward over more than four years (around 25% of them). It is possible to derive from tables 5 and 6, therefore, that large and medium-sized firms post losses far more frequently and carry losses forward for a somewhat longer time. It should be remembered, however, that tax regulations covering loss carrybacks may already suffice to prevent small firms from having to carry losses forward.

[12] For a precise assessment, loss carrybacks would also need to be considered. However, this empirical analysis only includes current financial statements, not corrected ones from the previous year.

Table 6. Number of periods with tax carryforwards (1971 to 2002)

	Small enterprises		Medium-sized enterprises		Large enterprises	
	Obs.	Firms	Obs.	Firms	Obs.	Firms
1	71,708 (31.40%)	10,039 (34.25%)	14,075 (29.67%)	2,313 (31.12%)	31,789 (26.45%)	4,370 (30.32%)
2	42,620 (18.66%)	6,205 (21.17%)	8,521 (17.96%)	1,437 (19.33%)	19,435 (16.17%)	2,739 (19.00%)
3	32,424 (14.20%)	4,598 (15.69%)	5,762 (12.15%)	987 (13.28%)	14,591 (12.14%)	1,974 (13.70%)
4	21,950 (9.61%)	2,732 (9.32%)	4,468 (9.42%)	708 (9.53%)	11,189 (9.31%)	1,383 (9.60%)
≥5	59,661 (26.13%)	5,737 (19.57%)	14,617 (30.81%)	1,988 (26.75%)	43,192 (35.93%)	3,946 (27.38%)
Total	228,363	29,311	47,443	7,433	120,196	14,412

On its own, however, the number of firms does not provide the full picture regarding the relevance of the negative effect of government tax revenue losses. Table 7 shows the sum total of loss carryforwards by size grouping for the years 1980, 1990 and 2000. The sum total of all losses carried forward by small firms rose from €440 million in 1980 to €2.3 billion in 2000. As the number of small firms declined over that period, the magnitude of the loss carryforwards per firm has risen significantly. Among large firms, the total increased more markedly, from €3.6 billion to just under €20 billion.[13]

[13] Assuming that firms post profits of a similar amount, corporation tax losses can be calculated by multiplying these figures by the tax rate.

Table 7. Revenue relevance of loss carryforwards (values in millions)

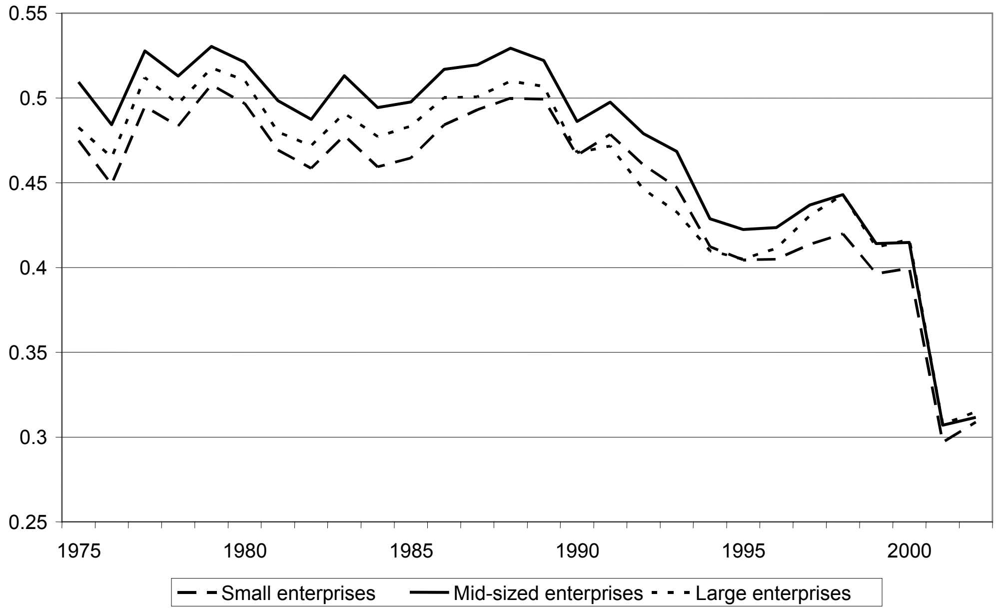
	Small enterprises	Medium-sized enterprises	Large enterprises
1980	-440.31	-295.83	-3,589.19
1990	-704.08	-399.40	-4,100.68
2000	-2,360.19	-1,644.03	-19,883.97

The effective marginal tax rates (calculated according to the Graham method) are central to this empirical study. These were determined using a simulation program I developed based on the method outlined in section 2.2 and using the data presented above.[14] Figure 1 illustrates the average effective marginal tax rates. According to Graham marginal tax rates are highest for medium-sized firms throughout the observation period. This is attributable to the results of the descriptive analysis, which found that, in comparison, these firms post losses more rarely and carry forward lower losses. By contrast, marginal tax rates are lowest for small enterprises. This is surprising given that it is also the group with the smallest losses and loss carryforwards; however, the relative size of the losses and loss carryforwards provides the explanation. If the annual pre-tax profit is low in comparison with the current tax carryforwards, then the marginal tax rate is lower than the income tax rate as a result. As the discrepancies between the groups are minor, the groups will not be evaluated separately in the following multivariate analysis.[15]

[14] The program was programmed in Stata; a copy may be obtained from the author on request.

[15] The multivariate analysis was also carried out for the individual size categories. Here, too, there were no discernible differences between the groups.

Figure 1. Graham's effective marginal tax rates by size



4 Marginal tax rate in empirical investment functions

The multivariate analysis investigates the suitability of Graham's marginal tax rate in empirical investment functions. Two model types have come to the fore in the empirical literature in recent years: the more reduced-form Autoregressive-Distributed-Lag (ADL) model and the somewhat more structural-form Error-Correction-Model (ECM). Typically, these studies have focused on the elasticity of the user cost of capital as a determinant for investment behaviour; it is particularly relevant to monetary transmission.[16] The present analysis disregards both the interest-rate channel and methods of offsetting depreciation. Instead, it centres on the applicable marginal tax rate given expected pre-tax earnings (including loss-offsetting). I shall only discuss the additional explanatory variables used in the models with reference to their sign and magnitude.

[16] For Germany, empirical evidence indicates an elasticity of around 0.3 (Harhoff and Ramb, 2001).

4.1 Econometric results

First, the marginal tax rate is inserted into an ADL model; equation (6) is estimated using fixed effects[17] and GMM.[18] The results can be found in table 8, the number of lag lengths used having been determined iteratively.[19] In the simple fixed effects estimation, the turnover, cash-flow and lagged endogenous variables all have the correct sign and are of an economically plausible magnitude. As a result, the long-run coefficients are comparable with those from other studies (Harhoff and Ramb, 2001). As expected, the contemporaneous and lagged variables for the marginal tax rate were negative. The long-run coefficient of 0.028 is highly significant, yet it seems comparatively low. The test statistics for autocorrelation indicate a higher-order autoregressive process.

As there may be a correlation between the lagged endogenous variable and the disturbance term, the fixed effects estimation is distorted.[20] Hence, the same specification was also estimated using a GMM model, considerably altering the results. The autocorrelation tests and the Sargan test of overidentifying restrictions direct us to the correct choice of specification for the autoregressive structure and instruments. A negative sign is expected for the lagged endogenous variable, which reflects the process of adjustment to the optimal capital stock. However, the lagged endogenous variable has the wrong sign and the long-run coefficients for turnover and the marginal tax rate appear implausibly high.

For large panel data sets (time and cross-section dimension), this phenomenon is not surprising because the high heterogeneity in the data can cause such distortions in the results.[21] The econometric literature proposes two possible solutions for this problem. One option is to use smaller samples which, for this data set, could be achieved by conducting sector-specific analyses, for example. The second approach tends to be more methodical in nature, requiring the statistical features of longer panel

[17] All fixed effects estimations were calculated using the first-difference estimation approach. Asymptomatically, this leads to the same results as the "within" estimation approach.
[18] The random effects estimation procedure proved unsuitable. The null hypothesis of the Hausmann test (i.e. no correlation between individual effects and explanatory variables) was rejected.
[19] The optimal lag lengths are determined by excluding insignificant lags.
[20] Known as the Nickell bias.
[21] For a discussion of this effect see Kiviet and Philips (1993).

data series.[22] When using only long data series, the inclusion of a lagged endogenous variable is of secondary importance. It can be shown that a simple fixed effects estimation is consistent and unbiased.

Table 8. Results of the ADL model

	Fixed effects		GMM	
Lag investment / capital	-0.427	(0.005) ***	0.079	(0.010) ***
Turnover (t)	0.102	(0.007) ***	0.435	(0.092) ***
(t-1)	0.090	(0.008) ***	0.200	(0.071) ***
(t-2)	0.031	(0.008) ***	0.113	(0.074)
(t-3)	0.006	(0.006)	0.034	(0.077)
Marginal tax rate (t)	-0.021	(0.001) ***	-0.109	(0.029) ***
(t-1)	-0.015	(0.002) ***	-0.072	(0.018) ***
(t-2)	-0.004	(0.001) ***	-0.045	(0.013) ***
Cash flow / capital (t)	0.126	(0.005) ***	0.067	(0.037) *
(t-1)	0.095	(0.005) ***	0.068	(0.021) ***
(t-2)	0.019	(0.004) ***	0.037	(0.013) ***
(t-3)	0.009	(0.003) ***	0.061	(0.027) **
Static long-run coefficients				
Turnover	0.161	(0.016) ***	0.678	(0.259) ***
Marginal tax rate	-0.028	(0.003) ***	-0.210	(0.068) ***
Cash flow / capital	0.174	(0.007) ***	0.220	(0.065) ***
Test AR 1	-22.72 [0.000] **		-25.48 [0.000] **	
Test AR 2	-30.48 [0.000] **		1.374 [0.169]	
Sargan test	/		96.05 [0.081]	
Firms / Observations	22,689 / 99,601		22,689 / 99,601	

Standard deviations of the estimated coefficients in parentheses (*** significant at the 1%, ** significant at the 5%, * significant at the 10% level). p-values for autocorrelation and Sargan tests in parentheses. All regressions include a dummy for a loss carryforward and a full set of time dummies. Instruments for the GMM estimation are lag 2 and lag 3 of the endogenous variable "investment in capital stock in the preceding period" and the explanatory variables "turnover growth", "growth rate of marginal tax rate" and the ratio of "cash flow to capital stock" in the preceding period.

The robustness check used a subsample of firms which had been included in the sample for at least 15 consecutive years. Table 9 lists the results for the fixed effects and GMM estimations.[23] The results of the fixed effects estimation differ only negligibly from those for the sample as a whole. By contrast, the GMM estimation is marked out by smaller long-run coefficients and insignificant parameters for the cash-flow term. This is due, in part, to the structure of the data. The subsample is characterised by larger

[22] In autoregressive panel data models, the Nickell bias lessens the longer the data series (see, for example, Arellano, 2003).

[23] The number of observations included in the estimations is less than 15 as, owing to lag formation and the instruments, the initial observations are not part of the estimation.

firms, which tend to have lower cash flow sensitivity than small and medium-sized enterprises.

Table 9. Results of the ADL model (robustness check)

	Fixed effects		GMM	
Lag investment / capital	-0.418	(0.013) ***	0.100	(0.026) ***
Turnover (t)	0.101	(0.018) ***	0.270	(0.108) ***
(t-1)	0.075	(0.022) ***	0.087	(0.028) ***
(t-2)	-0.001	(0.021)	-0.002	(0.028)
(t-3)	-0.007	(0.016)	0.023	(0.020)
Marginal tax rate (t)	-0.017	(0.003) ***	-0.051	(0.024) **
(t-1)	-0.014	(0.004) ***	-0.021	(0.010) **
(t-2)	-0.004	(0.003)	-0.013	(0.006) **
Cash flow / capital (t)	0.156	(0.023) ***	0.002	(0.075)
(t-1)	0.109	(0.017) ***	0.068	(0.045)
(t-2)	0.014	(0.015)	0.053	(0.037)
(t-3)	0.004	(0.013)	-0.050	(0.050)
Static long-run coefficients				
Turnover	0.119	(0.041) ***	0.254	(0.121) ***
Marginal tax rate	-0.025	(0.006) ***	-0.103	(0.038) ***
Cash flow / capital	0.199	(0.029) ***	0.025	(0.056)
Test AR 1	-8.455 [0.000] **		-13.23 [0.000] **	
Test AR 2	-12.12 [0.000] **		-0.1344 [0.893]	
Sargan test			110.3 [0.657]	
Firms / Observations	1340 / 14757		1340 / 14757	

Standard deviations of the estimated coefficients in parentheses (*** significant at the 1%, ** significant at the 5%, * significant at the 10% level). p-values for autocorrelation and Sargan tests in parentheses. All regressions include a dummy for a loss carryforward and a full set of time dummies. Instruments for the GMM estimation are lag 2 and lag 3 of the endogenous variable "investment in capital stock in the preceding period" and the explanatory variables "turnover growth", "growth rate of marginal tax rate" and the ratio of "cash flow to capital stock" in the preceding period.

Besides the ADL model, the empirical literature often uses the more structural Error-Correction-Model (equation 10).[24] Table 10 summarises the results obtained using such a model. Following the method used for an ADL model, step one is a fixed effects estimation, step two a GMM estimation and step three a fixed effects estimation for a robust subsample.

[24] Empirical results for Germany may be found in Harhoff and Ramb (2001).

Table 10. Results of the error correction model

	First differences		GMM		First differences (robust sample)	
Lag investment / capital	-0.408	(0.004) ***	0.089	(0.007) ***	-0.399	(0.012) ***
Turnover (t)	0.084	(0.007) ***	0.270	(0.064) ***	0.094	(0.019) ***
(t-1)	0.078	(0.009) ***	0.235	(0.067) ***	0.078	(0.023) ***
Marginal tax rate (t)	-0.018	(0.001) ***	-0.016	(0.005) ***	-0.013	(0.004) ***
(t-1)	-0.001	(0.002)	-0.013	(0.006) **	0.004	(0.005)
Cash flow / capital (t)	0.107	(0.005) ***	0.140	(0.014) ***	0.133	(0.020) ***
Log turnover (t-2)	-0.030	(0.011) ***	0.107	(0.064) *	-0.058	(0.026) **
Log marginal tax rate (t-2)	0.010	(0.002) ***	-0.014	(0.007) **	0.016	(0.005) ***
ECM term (t-2)	-0.018	(0.006) ***	-0.072	(0.011) ***	-0.042	(0.018) **
Test AR 1	-29.32 [0.000] **		-44.22 [0.000] **		-11.22 [0.000] **	
Test AR 2	-36.07 [0.000] **		-1.352 [0.176]		-13.62 [0.000] **	
Sargan test			274.0 [0.000] **			
Firms / Observations	22,689 / 122,290		22,689 / 122,290		1,340 / 16,097	

Standard deviations of the estimated coefficients in parenthesis (*** significant at the 1%, ** significant at the 5%, * significant at the 10% level). p-values for autocorrelation and Sargan tests in parentheses. All regressions include a dummy for a loss carryforward and a full set of time dummies. Instruments for the GMM estimation are lag 2 and lag 3 of the endogenous variable "investment in capital stock in the preceding period" and the explanatory variables "turnover growth", "growth rate of marginal tax rate" and the ratio of "cash flow to capital stock" in the preceding period. The variables "log turnover", "log marginal tax rate" and the error correction term were all self-instrumented.

The fixed effects estimation for the entire sample provides plausible and significant coefficients for the lagged endogenous variable, turnover growth and the cash flow variable. The second lagged variable for the logarithm of turnover should be viewed as a test of constant returns to scale. The fact that the coefficients are significant supports this hypothesis. According to the model derivation (see equation 9), the long-run coefficient for the marginal tax rate is expressed by $(\gamma_0 + \gamma_1 + \gamma_2) = 0.010$.[25] However, the positive sign contradicts the expected coefficient which, theoretically, should be negative. Although the GMM estimation provides plausible values for these coefficients, they are very low. Furthermore, the lagged endogenous variable (which reflects the speed of adjustment) bears the wrong sign. Using a subsample with firms for which at least 15 observations are available and estimating a fixed effects model does not alter the result obtained using the full sample.

4.2 Discussion

To the best of the author's knowledge, this is the first empirical study for Germany to test marginal tax rates calculated using the Graham method in investment models. Below, I shall discuss the suitability of the marginal tax rate for the empirically estimated investment models. I shall not offer a detailed interpretation of the other variables used in the estimations, but merely check their plausibility. Generally, it holds that the Graham method marginal tax rate can be meaningfully interpreted, in one of the investment models. However, it appears that the method can only be applied when specific conditions concerning the data structure and estimation technique are fulfilled.

The ADL model provides plausible and significant results for the marginal tax rate and the other explanatory variables. The results indicate that the long-run elasticity of the marginal tax rate to investment activity is between 0.1 and 0.2. However, the larger the firm, the lower the elasticity. Provided we ignore the taxation paradox described in the literature, the results appear entirely plausible from a theoretical standpoint. Although the probability of making losses (see also the descriptive analysis) and therefore being subject to a lower tax rate (or, in extreme cases, a zero rate) increases the larger the firm, its relevance to investment activity is only minor. From an econometric perspective, the GMM estimation of the simple fixed effects estimation is

[25] This is the coefficient for log marg tax rate (t-2) in table 10.

preferable. While the fixed effects estimation for the subsample shows less of a Nickell bias, the endogeneity problem remains for the right-hand side variables. The fact that the GMM estimation parameters are far more significant for the entire sample is due to the large sample size. Given that there are plausible reasons to explain the varying results obtained for the much smaller subsample, the GMM estimation can be said to provide efficient, consistent results.

The literature notes that the sign of the estimated coefficient for the expected marginal tax rate is generally undetermined. If a firm anticipates being taxed at a higher rate, it may be well-advised to boost its investment activity to benefit from the positive effects of methods used to offset depreciation. This is known as the taxation paradox and results in a positive tax rate effect on investment. The extent to which this applies to the present data set can be tested by modifying the specifications. One option is to divide the data set into periods of time subject to different depreciation rates. However, as a change was not made to the depreciation rate for machinery and equipment until 2001, it is not possible to attempt this with the available data set. Option two rests on the notion that the taxation paradox has a greater impact on profitable firms with a lower level of indebtedness (share of outside capital). Intuitively, a higher tax rate increases the present value of depreciation allowances (positive effect) and reduces future net income (negative effect). In firms with low net earnings marked by low indebtedness and low tax-deductible interest payments, the first effect predominates.[26] An ADL model estimation (using interaction terms) was conducted separately for profitable and non-profitable firms as part of the empirical analysis. The results are not listed in a table because the results did not detect a statistically significant difference between the two groups. This should be taken as an indication that the taxation paradox has only a slight bearing on this data set.

Results for the marginal tax rate from the more structural Error-Correction-Model are surprisingly unsatisfactory. Although the short-term parameters bear the correct sign, the parameters for the long-run relationship do not allow for meaningful interpretation. Theoretically, one would anticipate a negative correlation between the expected marginal tax rate and investment activity over the long term as well. One

[26] See, for example, Sinn (1987) and Weichenrieder (1995).

reason for the unsuitability of this type of model might be the rigid structure of the theoretical model; another, perhaps, an omitted variable bias. As the output and cash-flow variables have the correct sign and are significant, it is more likely that the construction of the marginal tax rate is unsuitable and not that the model specification is fundamentally flawed.

5 Summary and outlook

This study is the first empirical analysis of the relationship between the investment behaviour of firms and Graham's empirically developed simulated marginal tax rates. The principal idea behind these simulated marginal tax rates is to take account of the expected earnings situation and, hence, explicit inclusion of the intertemporal offsetting of tax losses. Hence, this approach differs from others frequently used in the literature, which typically assume firms are profitable. The traditional approaches disregard the fact that firms posting losses are taxed at a zero rate and, in addition, are able to carry these losses forward to another period. Given resident firms' increasing losses and loss carryforwards, this aspect is relevant, however. The objective is to acquire as comprehensive a picture as possible using a data set which is representative both in terms of its time dimension and the size of the firms.

The empirical analysis I conducted was based on the most comprehensive set of annual financial statements available to researchers: the Bundesbank's corporate balance sheet statistics. The study analysed more than 100,000 firms during the 1971-2002 observation period. The descriptive analysis shows that, during the observation period, around two-thirds of the firms posted a loss in at least one year or carried forward a loss at least once. The duration and amount of the losses vary according to the size of the firm – large firms tend to have higher losses over a longer period. A marked rise in losses and loss carryforwards since the 1990s is apparent. Graham's expected marginal tax rates, which are calculated to allow for losses and loss carryforwards, indicate only comparatively minor differences between the enterprise size categories. However, the average marginal tax ratebased on Graham's approach is far less than the income tax rate.

The multivariate analysis showed that the reduced form (ADL) model for the marginal tax rate produced plausible results. The estimated elasticity level is between 0.1 and 0.2. Therefore, a 10% cut in the marginal tax rate would entail an average increase of one to two percent in the propensity to invest. Note that this assumes an average overall effect which is dependent on changes to the tax rate and/or the offsetting of losses. The present methodology does not permit a breakdown into effects caused by the tax rate and those caused by the offsetting of losses. Note also that the firms are especially heterogeneous, which can precipitate various effects regarding expected investment activity. The more structural error correction model finds that the marginal tax rate is not suited to offering a plausible explanation of investment behaviour. One reason may be that the model has a less flexible structure which cannot adequately map the highly heterogeneous data.

The substantial results of this paper are the significant elasticities which are comparatively small. Against the background of the used fixed effects methods this is not surprising. The major tax effects will be absorbed by the fixed time effects. The results are only driven by the expected firm profitability. In a model which combines the Graham marginal tax rates and effective average tax rates (EATR) or effective marginal tax rates (EMTR) the elasticities will become higher.

The Graham marginal tax rates prove suitable in an ADL model. However, there are also drawbacks with this method. One particular Achilles' heel is that the depreciation allowances are disregarded. Nor does the calculation method include different forms of financing or potential interest-rate effects. For this reason, the method is better viewed as an additional source of information for an empirical analysis; it certainly has its place alongside the more well-known methods used for calculating effective marginal tax rates (EMTR) and effective average tax rates (EATR).

Future researchers would be well advised to compare and combine various methods for calculating the marginal tax rates side-by-side in a single data set. A comparison of the methods used to calculate the effective marginal tax rates (EMTR) and effective average tax rates (EATR) would be especially interesting. Such studies would contribute to our understanding of how marginal tax rates affect investment behaviour.

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