Empirische Analysen zur Unternehmensbesteuerung
(Empirical analysis on corporate taxation)

Inaugural-Dissertation
zur Erlangung des Doktorgrads
des Fachbereichs Wirtschaftswissenschaften
der Johann Wolfgang Goethe-Universität
Frankfurt am Main

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aus
Wadern

2007

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Tag der Promotion: 3. Mai 2007

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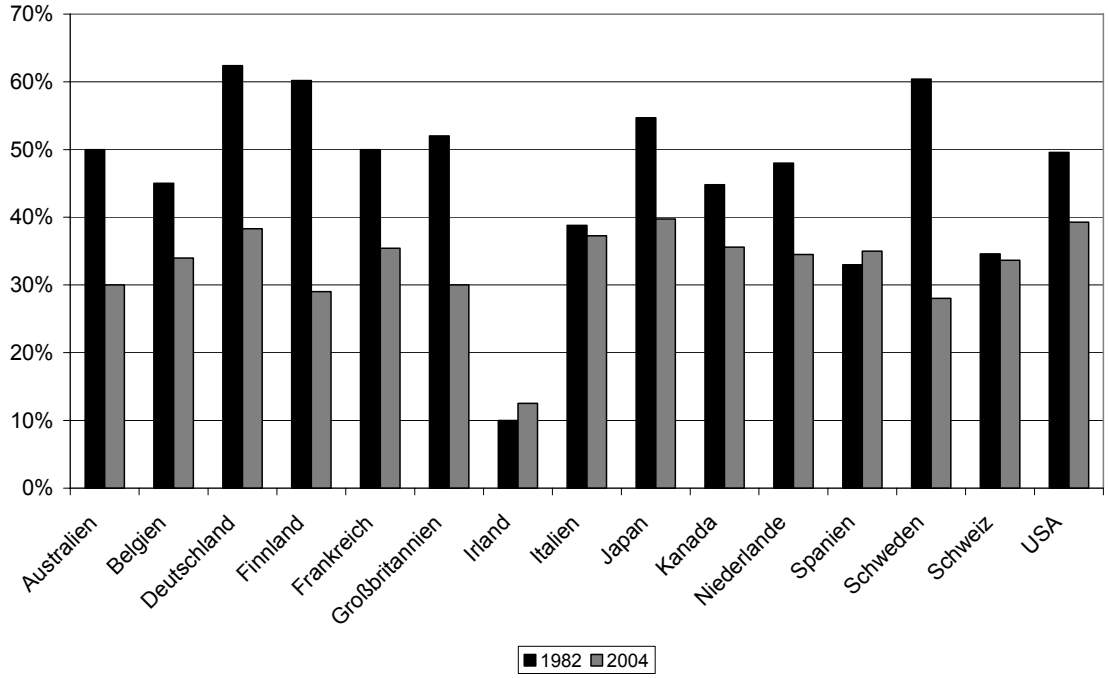
1 Motivation

Die vergangenen zwei Dekaden waren in den meisten Volkswirtschaften durch eine Globalisierung der Märkte gekennzeichnet. Dabei ist zwischen den Staaten ein Wettbewerb um den mobilen Faktor Kapital entstanden, der Wachstum, Investitionen, Beschäftigung und damit den Wohlstand garantieren soll. Eines der Instrumentarien um den konkurrierenden Faktor ist die Besteuerung der Unternehmen. Damit gilt diesem Aspekt sowohl in der Politik als auch in der wissenschaftlichen Forschung eine gestiegene Aufmerksamkeit. Hinsichtlich der Forschung, die den Zusammenhang zwischen der Unternehmensbesteuerung und dem unternehmerischen Kapitalstock untersucht, ist mittlerweile eine beträchtliche Zahl von Literatur entstanden. Aus der vorhandenen Literatur sind jedoch zwei Schwächen zu erkennen. Erstens basieren nach wie vor viele der empirischen Analysen auf makroökonomischen Zeitreihendaten. Diese weisen den Nachteil auf, dass keine ausreichende Berücksichtigung der Heterogenität des Unternehmenssektors erfolgt. Eine zweite Schwäche der bestehenden Arbeiten liegt in der Verwendung von Reduzierte-Form-Modellen. Die Entwicklung und der Einsatz von strukturellen Modellen, die das gezielte Testen von Hypothesen vereinfachen und tendenziell eine sinnvollere Interpretation zulassen, spielt noch eine untergeordnete Rolle.

Die Relevanz empirischer Arbeiten verdeutlicht sich an einigen Fakten hinsichtlich der Entwicklung der Steuersätze in ausgewählten Industrieländern. In den letzten Jahren ist in nahezu allen Industrieländern eine große Zahl von Steuerreformmaßnahmen zu beobachten. Die Abbildung 1 gibt einen ersten Überblick über die Reduzierung der Körperschaftsteuersätze in einigen Industrieländern.

* Die vorliegende Arbeit ist durch die Unterstützung einiger Personen entstanden. Mein besonderer Dank gilt Alfons Weichenrieder, der als Gutachter mit seinen Anmerkungen die Arbeiten inhaltlich vorangetrieben hat. Dies gilt auch für Thomas Hemmelgarn und Clemens Fuest, die wesentliche Anteile bei der Erstellung von zwei Forschungsarbeiten hatten. Nützliche Anregungen hinsichtlich der Daten kamen von Alexander Lipponer und Timm Körting. Mein Dank richtet sich auch an Heinz Herrmann, der zu allen Arbeiten wertvolle Kommentare lieferte.

Abbildung 1. Körperschafsteuersätze in 1982 und 2004

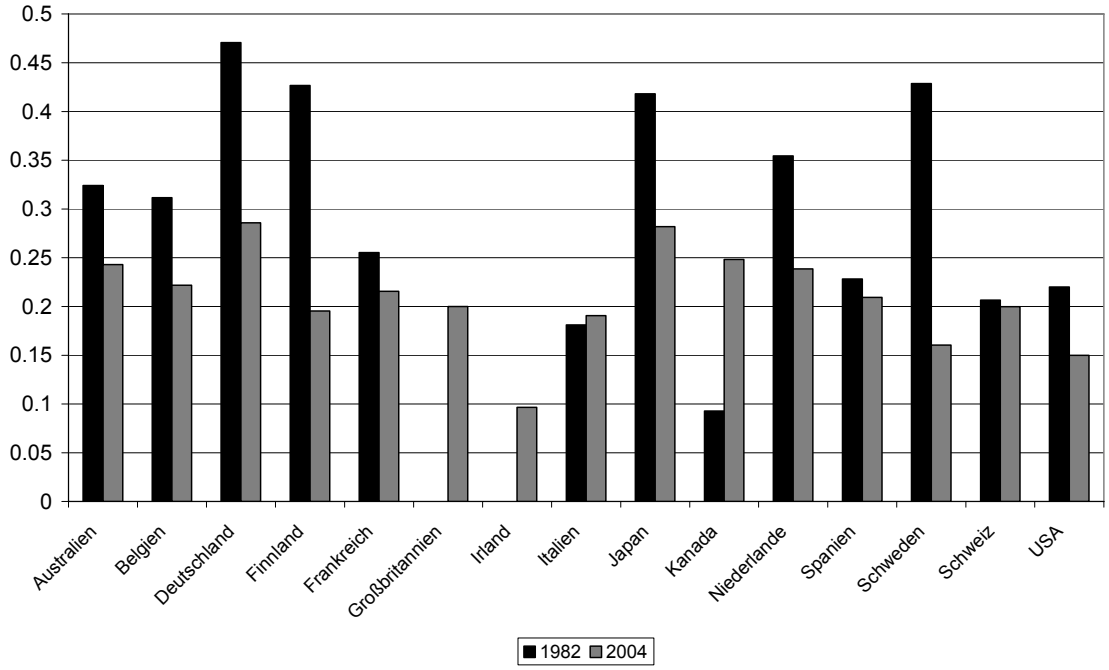


Quelle: Clark (2006)

Mit Ausnahme von Irland ist in allen dargestellten Ländern eine deutliche Reduzierung der tariflichen Steuersätze zu verzeichnen. Neben Schweden und Finnland ist vor allem in Deutschland eine deutliche Reuzierung der tariflichen Steuerbelastung zu verzeichnen.

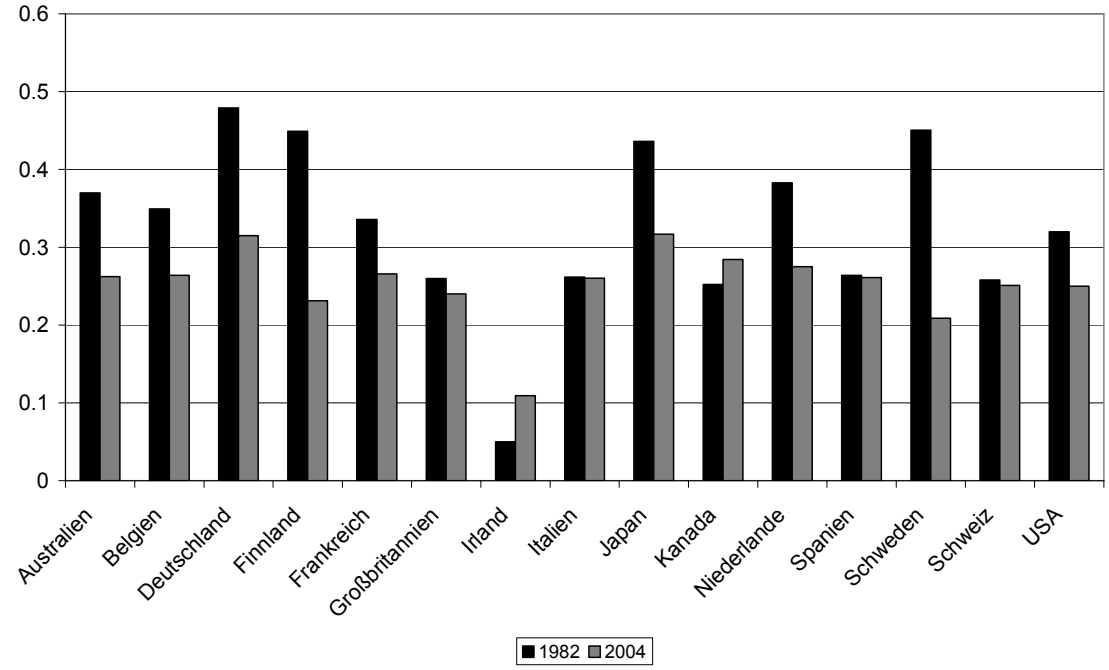
Da die tariflichen Steuersätze nur bedingt geeignet sind, um Aussagen über die effektive Steuerbelastung zu treffen, werden in der Literatur die Methode der effektiven marginalen Steuerbelastung (EMTR) und der effektiven durchschnittlichen Steuerbelastung (EATR) verwendet. Die Abbildungen 2 und 3 zeigen die durchschnittliche Belastung nach diesen Verfahren. Beide Verfahren belegen, dass sich die marginale Steuerbelastung in den dargestellten Ländern angenähert hat. Da die Zahlen nicht auf Mikrodaten beruhen und die Methoden nicht die gesamten steuerlichen Rahmenbedingungen erfassen, tragen sie nur einen begrenzten Maße zum Verständnis der Wirkungsweise der Besteuerung auf das unternehmerische Verhalten bei.

Abbildung 2. Effektive marginale Steuersätze in 1982 und 2004



Quelle: Clark (2006). Für Großbritannien und Irland liegen für 1982 keine Zahlen vor.

Abbildung 3. Effektive durchschnittliche Steuersätze in 1982 und 2004



Quelle: Clark (2006)

Die vorliegenden vier Arbeiten leisten einen Beitrag zur empirischen Forschung unter Verwendung von Mikrodaten und sollen vor allem das Verständnis von ausgewählten Teilbereichen der Unternehmensbesteuerung verbessern. Dabei konzentrieren sich die Arbeiten auf die Aktivitäten deutscher Unternehmen im In- und Ausland sowie ausländischer Unternehmen in Deutschland. Die Basis der Analysen bilden vor allem Daten der Deutschen Bundesbank, die über sehr große Datensätze mit teils einzigartigem Charakter verfügt. Die Arbeiten lassen sich in die drei Themenbereiche *Finanzierungsstruktur*, *einheitliche Bemessungsgrundlage* sowie *Messung marginaler Steuerbelastung* eingliedern.

Hintergrund des ersten Themenbereiches zur Finanzierungsstruktur ist die empirische Beobachtung einer zunehmenden konzerninternen Finanzierung von ausländischen Tochterunternehmen in Deutschland. Theoretische Überlegungen gehen davon aus, dass Unterschiede in der Besteuerung der Schuldzinsen eine grenzüberschreitende Fremdfinanzierung attraktiv erscheinen lassen und somit zu einer Verlagerung der im Inland erzielten Profite führen. Die vorgelegte Arbeit gliedert sich in eine Reihe von empirischen Untersuchungen ein, die für die USA (Altshuler and Grubert 2003 sowie Desai, Foley and Hines 2003) und Kanada (Jog und Tang 2001) vorliegen. Während in den erwähnten Arbeiten ein signifikanter Zusammenhang zwischen dem ausländischen Steuersatz und der Verschuldung nachgewiesen werden konnte, gibt die empirische Analyse für Deutschland nur einen begrenzten Hinweis auf eine derartige Beziehung. Dies kann einerseits auf Messprobleme zurückzuführen sein und andererseits in der Ermangelung eines geeigneten theoretischen Modells bedingt sein.

Der zweite Themenbereich, aus dem zwei Forschungsarbeiten hervorgegangen sind, beschäftigt sich mit dem Phänomen, dass multinationale Unternehmen zunehmend internationale Steuerarbitragemöglichkeiten ausschöpfen, um ihre effektive Steuerbelastung zu reduzieren. Die damit verbundenen Steuerausfälle, die Ungleichbehandlung zu rein national agierenden Unternehmen sowie die negative politische und öffentliche Bewertung dieser Praktiken führten zu der Diskussion um die Einführung einer einheitlichen steuerlichen Bemessungsgrundlage in der Europäischen Union (EU Kommission 2001). Derzeit gibt es einige Arbeiten, die diese Thematik diskutieren (Devereux 2004, Gordon and Wilson 1986, Mintz 2004, Mintz and Weiner

2003, Sorensen 2004, Shackelford and Slemrod 1998), allerdings mit nur geringer empirischen Evidenz für Deutschland.

Ausgangspunkt der zweiten Forschungsarbeit ist ein aktueller Fall, den der Europäische Gerichtshof (EuGH) verhandelt. Dabei geht es um die Frage, ob Verluste ausländischer Tochtergesellschaften bei der Mutterfirma im Inland von der Bemessungsgrundlage der Unternehmenssteuer abgezogen werden dürfen. Da eine entsprechende Verlustverrechnung im konkreten Fall innerhalb Großbritanniens, nicht aber grenzüberschreitend möglich ist, könnte dies ein Verstoß gegen die EU-Verträge sein. In der empirischen Analyse werden zu erwartende Steuereinnahmeeffekte für den deutschen Fiskus berechnet, die mit der Einführung einer EU-weiten Verlustverrechnung verbunden wären. Für den Zeitraum von 1998 bis 2002 wäre den Berechnungen zur Folge mit Steuerausfällen in einer Größenordnung von etwa 30 Milliarden Euro zu rechnen.

Die dritte Forschungsarbeit setzt an der Thematik der grenzüberschreitenden Verlustverrechnung an und analysiert die zu erwartenden Effekte, die sich mit der Einführung einer EU-weiten Benessungsgrundlage unter Berücksichtigung einer Zuteilungsformel ergeben. Hier sind die Resultate richtungsweisend für künftige finanzpolitische Entscheidungen der Europäischen Union. Eine Zuteilungsformel, die sich an der ökonomischen Aktivität der Unternehmen orientiert, würde zu einem deutlichen, EU-weiten Rückgang der nationalen Bemessungsgrundlagen führen. Tendenziell sind jedoch kleine Länder und Länder, die steuerliche Anreize für Buchprofite geben, stärker betroffen.

Im Unterschied zu den ersten drei Forschungsarbeiten ist das vierte Forschungsprojekt tendenziell eher methodischer Natur. In der empirischen Literatur kristallisierten sich in den vergangenen Jahren zwei Methoden heraus, die zur Messung der marginalen Steuerbelastung von Unternehmen herangezogen werden. Wie eingangs skizziert dominieren die Methode des effektiven marginalen Steuersatzes (EMTR) und des effektiven Durchschnittssteuersatzes (EATR) die empirische Literatur. Eine Übersicht über diese Methoden und empirischen Ergebnisse geben Devereux, Griffith und Klemm (2002). Diese Ansätze sind jedoch nicht unumstritten. Der Nachteil besteht darin, dass Unternehmen mit Verlusten unzureichend in der Methodik berücksichtigt

bleiben. An diesem Punkt setzt die von Graham (1996a und 1996b) entwickelte Methode der simulierten marginalen Steuersätze an, die endogen die Ertragssituation berücksichtigt. In der durchgeführten Analyse wird erstmals für Deutschland die Eignung dieser Methodik anhand ausgewählter Investitionsfunktionen überprüft. Die vorliegenden Ergebnisse zeigen, dass die Methode sinnvoll in Investitionsfunktionen eingesetzt werden kann und somit die empirische Literatur ergänzt.

Die vorliegenden Forschungsarbeiten dienen als Ergänzung zur bestehenden empirischen Literatur. Durch die Verwendung von vertraulichen Mikrodaten geben die Arbeiten einen Beitrag zum Verständnis aus den Teilbereichen der *Finanzierunkstruktur*, der *gemeinsamen Bemessungsgrundlage* sowie der *Messung der marginalen Steuerbelastung*. Darüber hinaus können die Analysen eine Diskussionsgrundlage für die Ausgestaltung künftiger Steuerpolitik in Deutschland und der EU sein. Angesichts der bislang geringen empirischen Evidenz für Deutschland wurden die Arbeiten bereits mit Interesse aufgenommen. Drei der vier vorliegenden Arbeiten sind in Fachzeitschriften publiziert (bzw. eine der Arbeiten erscheint 2007). Im Folgenden werden die wesentlichen Resultate der Arbeiten zusammengefasst.

2 Kurzzusammenfassung der Arbeiten

2.1 Taxes and the financial structure of German inward FDI (Fred Ramb and Alfons J. Weichenrieder)

Das erste Papier entstand gemeinsam mit Alfons Weichenrieder (Goethe-Universität Frankfurt) und ist in der Fachzeitschrift *Review of World Economics* (Vol. 141, No. 4, 2005, S. 670-692) erschienen. Das Papier analysiert auf Basis eines Reduzierte-Form-Modells die Finanzierungsstruktur von ausländischen Direktinvestitionen in Deutschland außerhalb des Finanzsektors. Im Jahr 2001 wurden bei diesen durchschnittlich 25 % der Bilanzsumme durch firmeninternes Fremdkapital finanziert. Für Unternehmen, die einem ausländischen Investor direkt, also ohne deutsche Zwischengesellschaft angehören, entfallen dabei auf grenzüberschreitende Intrafirmenkredite 20 % der Bilanzsumme. Oft werden Steuern als Erklärung für diesen hohen Umfang angeführt. Unterliegen die Zinsen im Ausland einem niedrigen Steuersatz und sind sie als Schuldzinsen gegen einen hohen deutschern Steuersatz absetzbar, resultiert insgesamt eine Steuerersparnis. Weil diese mit dem

Auslandssteuersatz abnimmt, sollte man erwarten, dass die grenzüberschreitende Fremdfinanzierung insbesondere dann anzutreffen ist, wenn die Mutter der deutschen Tochter einen niedrigen Steuersatz hat. Anhand eines Panel-Datensatzes mit ca. 8.000 Auslandstöchtern in Deutschland ergibt sich nur begrenzte Evidenz dafür, dass der Heimatsteuersatz des ausländischen Investors für den Umfang der konzerninternen Fremdfinanzierung bedeutsam ist. Zum Teil könnte dies mit der fehlenden Information über die Gewinn- bzw. Verlustsituation des ausländischen Investors zusammenhängen.. Die begrenzte Evidenz zum Einfluss des Auslandssteuersatzes sollte jedenfalls nicht dahingehend interpretiert werden, dass bei der konzerninternen Fremdfinanzierung Steuerwägungen keine Rolle spielen. Die Ergebnisse zeigen, dass Unternehmen, die im Durchschnitt über die Jahre profitabel sind, mit ihren Krediten stärker auf Änderungen des deutschen Körperschaftsteuersatzes reagieren als andere Unternehmen. Dies legt nahe, dass der deutsche Steuersatz eine wichtige Rolle für die Höhe der internen Fremdfinanzierung spielt. Im Hinblick auf Fremdkapital von Dritten zeigt sich ein signifikanter Effekt der deutschen Steuer bei Töchtern, die über eine deutsche Zwischengesellschaft gehalten werden, nicht jedoch bei unmittelbaren Auslandstöchtern.

Die Fremdfinanzierungsentscheidungen sind sicherlich nicht ausschließlich von steuerlichen Erwägungen getrieben. Ein anderer wichtiger Einfluss ist die (geringe) Profitabilität. Der Großteil der grenzüberschreitenden Firmenkredite wird von Unternehmen gehalten, die Verluste verzeichnen. Die Paneldatenanalyse liefert Hinweise dafür, dass eine Gewinnverringerung um ein Prozent der Bilanzsumme mit einer Erhöhung der Intrafirmenkredite um 0,3 Prozent der Bilanzsumme einhergeht.

2.2 The Tax Revenue Implications of Marks & Spencer for Germany (Clemens Fuest, Thomas Hemmelgarn and Fred Ramb)

Das zweite Papier ist im Rahmen eines Gemeinschaftsprojekts mit Clemens Fuest und Thomas Hemmelgarn von der Universität Köln bei *Tax Notes International* (May 30, 2005, S. 763-767) erschienen.

Ein aktueller Fall, den der EuGH verhandelt, könnte die Zukunft der Unternehmensbesteuerung und die nationalen Steuereinnahmen maßgeblich beeinflussen. Im so genannten Fall *Marks & Spencer* (C-443/03) geht es um die Frage,

ob Verluste ausländischer Tochtergesellschaften bei der Mutterfirma im Inland von der Bemessungsgrundlage der Unternehmenssteuer abgezogen werden dürfen. Dies ist in Großbritaannien für inländische Mutterunternehmen mit inländischen Töchtern möglich (group relief), jedoch nicht für ausländische Tochterfirmen. Dadurch werden ausländische Tochterfirmen benachteiligt. Da eine Diskriminierung grenzüberschreitender Investitionen gegenüber inländischen Vorgängen gegen EG-Recht verstößt, wird erwartet, dass der EuGH der Klage von Marks & Spencer stattgibt und die grenzüberschreitende Verlustverrechnung ermöglicht.

Ein solches Urteil hätte weit reichende Folgen für die nationalen Steuer- und Finanzpolitiken. Auch in Deutschland könnten Unternehmen das Recht einklagen, in der Vergangenheit aufgetretene Auslandsverluste Steuer mindernd mit inländischen Gewinnen zu verrechnen. Für die Zukunft müssten auch die deutschen Regelungen zur grenzüberschreitenden Verlustverrechnung dem EG-Recht angepasst werden. Die Einführung einer grenzüberschreitenden Verlustverrechnung in der EU wirft vielfältige ökonomische und finanzpolitische Fragen auf. Im Mittelpunkt der finanzpolitischen Debatte steht derzeit allerdings die Frage, welche fiskalischen Konsequenzen die EuGH-Rechtsprechung haben könnte. Es wird befürchtet, dass vor allem eine rückwirkende Verlustverrechnung zu Steuererstattungen führen könnte, welche die ohnehin angespannten öffentlichen Haushalte vor weitere Probleme stellen würde. Darüber hinaus stellt sich die Frage, wie sich eine grenzüberschreitende Verlustverrechnung auf die Steuereinnahmen auswirken würde. Dies wird von der genauen Ausgestaltung der Verlustverrechnung abhängen. Derzeit wird die Einführung einer Verlustverrechnung mit einer Nachversteuerung im Fall später auftretender Auslandsgewinne diskutiert. Eine solche Nachversteuerungsregelung könnte die zu erwartenden Aufkommensverluste begrenzen. Ob und in welchem Umfang dies erreicht wird, hängt von der Struktur der Verlust- und Gewinnverläufe der Auslandsinvestitionen ab.

Vielfach wird vermutet, dass eine grenzüberschreitende Verlustverrechnung zu Steuerausfällen in Milliardenhöhe führen könnte. Bislang liegen allerdings keine Berechnungen vor, welche die zu erwartenden Aufkommensverluste quantifizieren. Das Papier untersucht unter Verwendung der Mikrodatenbank Direktinvestitionsbestände der Deutschen Bundesbank, welche Aufkommenswirkung die Einführung einer EU-

weiten Verlustverrechnung für den deutschen Fiskus hätte. Die Analyse verwendet die in der Vergangenheit beobachteten Gewinne und Verluste deutscher Direktinvestitionen im EU-Ausland.

Welche Aufkommenswirkung eine Verlustverrechnung auf europäischer Ebene für den deutschen Fiskus hat, hängt von der Ausgestaltung der Verrechnungsregel ab. Ohne eine Nachversteuerung ausländischer Gewinne ist mit erheblichen Steuerausfällen zu rechnen. Rückblickend wären Werte von insgesamt rund 30 Milliarden Euro für die Jahre 1998 bis 2002 möglich. Dabei wurde angenommen, dass die Verlustverrechnung die Gewerbesteuer nicht betrifft. Wird eine Nachversteuerungsregel eingeführt, so zeigt die Analyse, dass die Steuerausfälle zwar geringer sind, jedoch bei weitem nicht ausgeglichen werden können. Dazu ist das Steueraufkommen aus der Nachversteuerung mit durchschnittlich 500 Millionen. Euro pro Jahr zu klein.

In den Berechnungen sind keine Verhaltensänderungen der Unternehmen berücksichtigt. Geht man davon aus, dass Unternehmen systematisch versuchen, Gewinne in Niedrigsteuerländern und Verluste in Hochsteuerländern anfallen zu lassen, so dürften die in Deutschland deklarierten Verluste höher sein als hier angenommen.

2.3 How would formula apportionment in the EU affect the distribution and the size of the corporate tax base? An analysis based on German multinationals (Clemens Fuest, Thomas Hemmelgarn and Fred Ramb)

Aus der Kooperation mit Clemens Fuest und Thomas Hemmelgarn von der Universität Köln ist ein weiteres Papier entstanden, dass den Refereeprozess bei *International Tax and Public Finance* erfolgreich durchlaufen hat und voraussichtlich im Frühjahr 2007 publiziert wird..

Die EU-Kommission hat in ihrem Bericht zur Unternehmensbesteuerung im europäischen Binnenmarkt aus dem Jahre 2001 den Vorschlag gemacht, eine einheitliche europäische Bemessungsgrundlage für europaweit tätige Unternehmen zu schaffen. Eine solche einheitliche Bemessungsgrundlage soll nach Vorstellung der EU-Kommission (wie eingangs beschrieben) anhand einer bestimmten Zuteilungsformel auf die Länder verteilt werden. Die Faktoren in der Formel sollen die Aktivität der jeweiligen Unternehmen in den Ländern berücksichtigen. Mögliche Zuteilungsfaktoren, die die ökonomische Aktivität eines Unternehmens in einem Land messen, wären etwa

die Umsätze, die Sachanlagen oder die Lohnsumme eines Unternehmens. Eine solche einheitliche EU-Bemessungsgrundlage soll die Anreize zu Gewinnverschiebungen der Unternehmen reduzieren und vor allem die Kosten der Unternehmen senken, die durch den Umgang mit 25 verschiedenen Steuersystemen in der EU entstehen.

Die vorliegende Arbeit unternimmt einen ersten Versuch, den Effekt der Einführung einer solchen einheitlichen EU-Bemessungsgrundlage und der damit verbundenen Zuteilungsregeln auf die Höhe der Bemessungsgrundlage und ihre Verteilung auf die EU-Mitgliedsländern zu messen. Dieser Versuch wird durch die Datenlage erschwert, denn zurzeit liegen keine Daten eines repräsentativen Ausschnitts europäischer multinationaler Unternehmen vor. Daher werden in diesem Aufsatz nur Daten deutscher multinationaler Unternehmen mit ausländischen Töchtern in der EU verwendet. Ein solches Vorgehen ist vertretbar, wenn man davon ausgeht, dass multinationale Unternehmen aus anderen Mitgliedsländern eine ähnliche Gewinn- und Verlust-Verteilung aufweisen und es somit möglich ist, von den Ergebnissen für deutsche multinationale Unternehmen auf EU-weite Effekte zu schließen.

Zur Berechnung der Effekte wird ein kombinierter Mikro-Datensatz auf Firmenebene verwendet, der sich aus der Mikrodatenbank Direktinvestitionen (MiDi) der Deutschen Bundesbank und Unternehmensbilanzstatistiken (Ustan und Hoppenstedt) zusammensetzt. Mit diesen Daten für die Jahre 1996 bis 2001 werden die Bemessungsgrundlage im Status Quo und die Bemessungsgrundlage für den Fall einer einheitlichen EU-Bemessungsgrundlage mit Zuteilungsfaktoren kalkuliert, die ebenfalls aus dem Datensatz berechnet wurden.

Ein Vergleich der Zahlen für beide Szenarien zeigt, dass in der Tendenz kleine Länder und insbesondere die kleineren Länder, die gemeinhin als attraktive Gastländer für Buchprofite gelten, in einem System mit Zuteilungsformel stärker verlieren als große Länder. Der Grund hierfür ist, dass in dem in unserer Stichprobe betrachteten Zeitraum große Länder im System getrennter Buchführung eine zu geringe Bemessungsgrundlage erhalten, wenn man die ökonomische Aktivität im Land für eine Zuteilung einer einheitlichen Bemessungsgrundlage zugrunde legt. Diese Beobachtung bestätigt sich, wenn wir die Zuteilungsformel ohne Berücksichtigung einer internationalen Verlustverrechnung anwenden. In diesem Fall gewinnen die großen

Länder oder stellen sich zumindest nicht schlechter, während die kleineren Länder zum Teil deutlich verlieren.

Neben der neuen Verteilung des Steueraufkommens zeigt sich auch ein deutlicher Effekt auf die Summe der Steuerbemessungsgrundlagen aller Länder. Die Einführung einer einheitlichen Basis würde im verwendeten Datensatz zu einem Rückgang der gesamten Bemessungsgrundlage führen. Der Grund hierfür ist die Möglichkeit eines internationalen Verlustausgleichs, der die Bemessungsgrundlage entsprechend reduziert.

Diese Ergebnisse müssen jedoch angesichts der sehr schwierigen Datengrundlage vorsichtig bewertet werden. Es stehen nur Daten für deutsche multinationale Unternehmen und deren Tochterfirmen zur Verfügung und dies auch nur für einen begrenzten Zeitraum, der möglicherweise nicht repräsentativ ist. Wir betrachten somit nur einen Ausschnitt einer EU-Bemessungsgrundlage und zwar den Teil, der von deutschen multinationalen Unternehmen im betrachteten Zeitraum gebildet wird. Eine Verbesserung der Datenlage zur Berechnung europäischer Steuerfragen wäre daher von hohem Nutzen, um robustere Aussagen über die Entwicklung des Steueraufkommens machen zu können. Die Daten werden zur Zeit nur für die Länder berechnet, die vor dem 1. Mai 2004 Mitglieder der EU waren. Zusätzlich können mit diesen rückblickenden Daten keine Verhaltensänderungen der Unternehmen abgebildet werden, die bei einem solchem Systemwechsel zu erwarten sind.

2.4 Corporate Marginal Tax Rate, Tax Loss Carryforwards and Investment Functions – Empirical Analysis using a Large German Panel Data Set (Fred Ramb)

Der Zusammenhang zwischen der Besteuerung und dem unternehmerischen Investitionsverhalten ist Gegenstand einer großen Zahl empirischer Analysen. Die in der Literatur verwendeten Methoden der EMTR und EATR weisen jedoch eine wesentliche Schwäche auf. Ein wesentliche Annahme ist, dass Unternehmen einen Gewinn aufweisen. Die Möglichkeit eines Verlustes und dem damit verbundenen effektiven marginalen Steuersatzes von Null bleibt typischerweise unberücksichtigt. Eine Ausnahme hierzu stellt die von Graham entwickelte Methode der simulierten marginalen Steuersätze dar, die eine explizite Modellierung der Ertragssituation vorsieht. Im Rahmen dieses Ansatzes wird die steuerliche Verlustverrechnung explizit

berücksichtigt und kann damit als ein geeignetes Instrumentarium zur Analyse von Steuerreformmaßnahmen dienen.

Die vierte Arbeit entwickelt 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. Die deskriptive Analyse zeigt, dass etwa zwei Drittel der Unternehmen im Beobachtungszeitraum mindestens in einem Jahr Verluste und/oder einen Verlustvortrag ausweisen. Dabei unterscheiden sich die Länge und die Höhe der Verluste von der Größe eines Unternehmens, wobei große Unternehmen tendenziell höhere und zeitlich längere Verluste ausweisen. Seit den 90er Jahren lässt sich zudem ein deutlicher Anstieg der Verluste und Verlustvorträge beobachten. Die unter Berücksichtigung der Verluste und Verlustvorträge berechneten erwarteten marginalen Steuersätze nach Graham zeigen nur vergleichsweise geringe Unterschiede zwischen den Größenklassen der Unternehmen. Der durchschnittliche marginale Steuersatz liegt jedoch deutlich unter dem tariflichen Steuersatz.

Die multivariate Analyse liefert Anhaltspunkte für plausible Ergebnisse der marginalen Steuersätze in dem Reduzierte-Form-Modell (ADL-Modell). 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 der marginalen Steuersätze in einem Fehlerkorrekturmodell führt hingegen zu keinen plausiblen Ergebnissen. Zusammenfassend kann jedoch festgehalten werden, dass die Methode als eine zusätzliche Informationsquelle im Rahmen von empirischen Analysen anzusehen ist, die neben den bekannten Methoden der EMTR und EATR durchaus eine Berechtigung besitzt.

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I
Taxes and the financial structure of German inward FDI

1 Introduction

There is widespread concern that multinational firms may evade a large portion of their statutory tax burden by shifting income out of high-tax jurisdictions. While such a concern is certainly not restricted to Germany, the high statutory rates of corporate tax in Germany – at least until the recent tax reform in 2001 – make it most likely that the country is particularly prone to this problem. Throughout the 1990s Germany had the highest tax rate on retained corporate profits (including average local taxes) among OECD countries.

Income shifting may take the form of prices that depart from arms-length conditions and may imply excessive management and overhead fees, the setting of non-market interest rates within a group etc. Besides setting tax-efficient transfer prices on intra-firm trade, multinationals may also use the financial structure to minimise taxes and thereby allocate interest deductions to highly taxed affiliates for which this tax shield is most valuable. In this paper we want to explore to what extent the financial structure of German inward foreign direct investment (FDI) is due to tax-saving behaviour.[1] During the 1990s the net German FDI inflow was financed to a large extent by intra-company debt incurred outside Germany. According to Deutsche Bundesbank (1993), 61.9% of the German inflow of FDI in 1990 and 1991 was financed by intra-company loans, and this strong role of intra-company loans in German inward FDI has led to the suspicion that these loans are indeed encouraged by high German tax rates (Deutsche Bundesbank 1997, page 67f, Weichenrieder 1995, page 183). To the best of our knowledge this paper is the first attempt to look at this question using German firm-level data on inward FDI and unlike previous studies we use not only variations in the tax rate of the subsidiary but also variations in the tax rate of the parent firm to test for financial effects at the level of the subsidiary.

[1] For papers that provide evidence on tax motivated transfer pricing policies of multinationals see, for example, Grubert and Mutti (1991), Collins and Shackelford (1998), or Rousslang (1997).

Our study is based on the Bundesbank FDI statistics that cover all foreign direct investments, which meet mild size requirements. Unlike most studies on FDI with non-U.S. data, we can draw on micro data from 1989 – 2002 to study this question and a panel structure is available for the years 1996 – 2002.[2]

While there is a large number of studies on the tax effects on FDI, most are concerned with the effect of local taxes on the overall FDI inflow of a region.[3] There are only a few studies on the financial structure. Notable exceptions are studies by Altshuler and Grubert (2003), Jog and Tang (2001), and Desai, Foley, and Hines (2003a). Altshuler and Grubert consider a cross-section sample of US subsidiaries abroad and analyse the liability and asset side of these firms. The study shows an inverse relationship between the foreign tax rate and the amount of financial assets held abroad. On the liability side, a 1 percentage point increase in the foreign tax rate is associated with an increase of roughly .4 percentage point in the debt to total asset ratio. The paper by Jog und Tang looks at US and Canadian firms. The authors show that the reduction in the Canadian corporate tax rate in the late 1980s triggered a reduction in the debt ratio of Canadian affiliates. Finally, Desai, Foley, and Hines find for a panel of US-owned foreign firms that a 1 percentage point increase in the foreign corporate tax rate leads to an increase in the external debt to asset ratio of roughly .25 percentage point and an increase in internal borrowing of some .08 percentage point.

In section 2 we will briefly discuss the tax arbitrage possibilities of multinational firms that consider alternative ways of financing their German investment. In Section 3 the Deutsche Bundesbank FDI database is used to present descriptive statistics of financial structures of German inward FDI.[4] By identifying the home countries of foreign affiliates operating in Germany and employing the respective tax rate of the parent, we are able to proxy the global tax saving of a profitable firm that decides to distribute a euro of equity to its parent and to replace this euro by an intra-company loan granted by the parent. Section 4 develops the empirical model and presents the econometric results before section 5 concludes.

[2] For reasons of data protection the data before 1996 have been anonymised, and the panel structure has therefore been lost.
[3] For a detailed survey and meta study see Ederveen and de Mooij (2001).
[4] For a description of this database see Lipponer (2003).

Our empirical analysis is based on a huge panel of more than 8,000 firms. We find that the corporate tax rate of the parent, which has been omitted in previous studies, has no significant impact on the financial structure of a German subsidiary. Conversely, a significant effect of the German tax rate is visible for firms that are directly owned by foreign investors. To identify this influence, we exploit the fact that unprofitable firms should be less affected by a change in the German corporate tax than profitable firms. Indeed, our results show that among German subsidiaries, which are directly held by a foreign investor, profitable firms react significantly different from non-profitable firms. When the German tax rate increases, profitable firms that are directly owned by a foreign investor significantly increase the amount of intra-company debt compared to unprofitable foreign-owned firms. This effect is absent though for subsidiaries that are held via intermediate German affiliates, the majority of which does not use cross-border intra-company loans.

Besides tax incentives, our study identifies (low) profitability as a major factor that explains the diversity of intra-company loans. Roughly 60% of the cross-border intra-company debt turns out to be held by firms that are running losses and profitability turns out to be highly significant in our panel regressions of intra-company loans.

2 The tax preferences for intra-company loans

From a tax perspective, the incentives for a foreign parent to grant an interest bearing loan to a profitable German subsidiary will depend on the German tax rate at which the interest is deductible, on the one hand, and the tax rate at which the interest is taxable in the home country of the parent, on the other hand.

To be more specific, consider the option of a German affiliate to use its profit to pay back an intra-company loan granted by the parent. Let τ_r^*, τ_d^*, τ_i^* be the effective corporate tax rates on German retained earnings and on earnings that are distributed from the German subsidiary to the foreign parent and the rate at which the German affiliate can deduct interest paid to the parent. The latter rate may fall short of the rate on retained earnings since in Germany only half of the interest on medium and long-term debt is deductible from the local trade tax (Gewerbesteuer). The rate τ_d^* is an effective rate that is influenced by the German corporate tax on distributed profits, by

the German withholding tax on dividends and by additional taxes in the home country of the parent if this country does not exempt foreign dividends.

If the German affiliate pays back a loan of €1 today, the parent is able to distribute this €1 as a dividend to its own shareholders. This however, comes at a cost. To pay back a loan of €1, the German affiliate needs a pre-tax income of $1/\left(1-\tau_r^*\right)$ euro. Since this sum is not available for profit distribution, the parent forgoes $\left(1-\tau_d^*\right)/\left(1-\tau_r^*\right)$ euro in dividends. Hence, the total change in dividends that the parent can pay today (before personal taxes of the shareholder of the parent) is given as

$$a \equiv 1-\frac{\left(1-\tau_d^*\right)}{\left(1-\tau_r^*\right)} \tag{1}$$

There is, however, an additional effect on future dividends. Since the debt service of the affiliate drops by the tax deductible interest rate on the retired loan, dividends may rise by $i\left(1-\tau_i^*\right)$ in all future periods, where i is the nominal interest rate. Since these dividends are taxed at the rate for distributed profits rather than at the rate on retained earnings, the parent receives a stream of dividends of $i\left(1-\tau_i^*\right)\cdot\left(1-\tau_d^*\right)/\left(1-\tau_r^*\right)$, the cash value of which is

$$b \equiv \frac{i\left(1-\tau_i^*\right)\cdot\left(1-\tau_d^*\right)}{\left(1-\tau_r^*\right)\cdot i(1-m)}, \tag{2}$$

where $i(1-m)$ is the discount rate applied by a shareholder of the parent.

A third effect that has to be taken into account is that the parent in all future periods lacks the interest income on the retired euro. Denoting the parent firm's tax rate at which the interest is taxable by τ, the cash value of this effect amounts to

$$c \equiv \frac{i(1-\tau)}{i(1-m)} \tag{3}$$

Obviously, assuming constant tax rates and abstracting from taxes on capital gains, the profitability of the intra-company loan depends on the sign of $(a+b-c)$. If this sign is negative, intra-company loans dominate equity in the form of retained

earnings as a source of finance for the German affiliate. One problem in international studies such as ours is that one can only speculate about the applicable tax rate *m* of the final investor. We follow a standard assumption in the literature on the international cost of capital (OECD 1991) and assume that the final investor is tax exempt (*m* = 0). Consequently,

$$DIFF = -(a+b-c) = (1-\tau_d^*)\tau_i^* / (1-\tau_r^*) - \tau \qquad (4)$$

is an indicator of the tax dominance of intra-company loans over retained earnings of the German affiliate. It should be noted that DIFF is also the relevant indicator for the tax advantage of reducing the third-party debt of the German affiliate by €1 and increasing the third-party debt of the foreign parent by €1. In this case the capital market can be thought of as financing a back-to-back transaction with the affiliate and the parent. Moreover, things are very similar if the corporation is considering a new equity injection by the parent or, alternatively, an intra-company loan to finance the subsidiary. Again, it can be shown that the relationship between the German and the foreign tax rates is crucial.[5]

The above arbitrage argument assumed that the parent and the German affiliate are profitable and do pay taxes. For German firms that are unprofitable, however, the right to deduct interest from the high taxed German tax base tends to be less valuable. At best, such a firm may be able to use a loss carry-backward or a loss carry-forward to decrease taxable income in other fiscal years. In the case of a loss carry-forward this comes at a cost as the loss carry forward is not interest bearing. The effective rate at which interest is deductible reduces. Conversely, if the parent firm, which receives the interest income, is running losses, then the effective tax rate may be lower than the statutory tax rate τ. Unfortunately, we do not know about the tax status of the parent so we cannot exploit such a difference in effective rates.

From the above argument we have that the profit or loss position of the German affiliate changes the influence of the Germany tax rate since it may reduce the value of the interest deduction, but, given the profit or loss position of the parent, it does not

[5] For an extensive discussion of the tax-induced financial preferences of multinational firms see Alworth (1988), Keen (1991) or Weichenrieder (1995).

change the effective tax rate at which interest income of the parent is taxed. This suggests to split up the variable DIFF into a German part and a foreign part when the profit or loss position of the German subsidiaries is considered in the empirical implementation. Firms that do pay taxes are expected to react more strongly to a German tax rate change than firms that are in a loss position.

3 Descriptive statistics

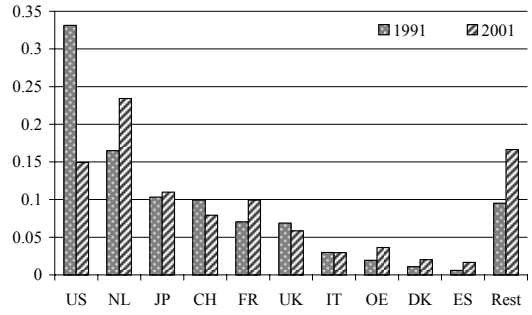
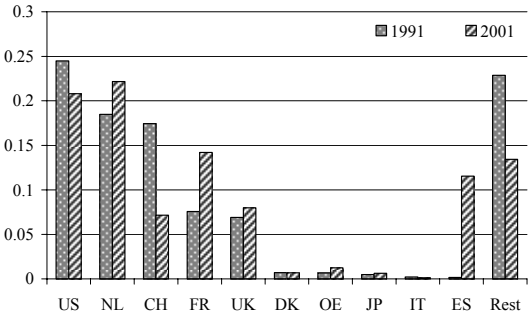
Despite its recently sluggish growth rates, Germany is still one of the main recipients of inward FDI. For end-2000 the OECD FDI statistics record an inward stock of FDI of €482 billion for Germany compared €277 billion for France, €121 billion for Italy and €479 billion for the UK. The present section gives information on the overall financing patterns of the German FDI stock and additional stylised facts. We will concentrate on non-financial firms (excluding banks, pure holding companies, and insurance companies) that are separately incorporated in Germany (dropping branches), and we will exclude investment in the government and not-for-profit sectors.

In its yearly survey of the stock of German inbound FDI, the Bundesbank collects data on the liability side of the balance sheets such as paid-up capital, capital reserves, profits and losses carried forward, and debt, including loans received from affiliated firms inside and outside Germany. The prime purpose of the data collection is to give a picture of the cross-border ownership of firms and the stocks of FDI in Germany. A somewhat unusual feature of the balance sheets collected by the Bundesbank is that they contain the yearly profit after taxes but before dividend distributions as a separate part of the equity of the firm. Therefore the balance sheets provide information on current profits despite the fact that there is no explicit profit and loss statement. On the asset side, data are available on fixed assets and intangibles, financial assets and working capital.

For each firm in the sample we can identify the foreign country of the investor, which may not be the ultimate investor but a foreign holding or intermediate company, and the share that this investor has in the German affiliate. An important distinction in the German data is the one between directly and indirectly held inward FDI. An indirect participation applies if the German affiliate is held by a German company that, in turn,

is owned by a foreign investor. A direct participation is defined as one where the German affiliate is directly owned by a foreign investor.

Figure 1. Main investors by country

a) Directly held affiliates	b) Indirectly held affiliates
	

Annotation: Investor countries by relative contribution to balance sheet total of directly and indirectly held foreign affiliates in Germany. United States (US), Netherlands (NL), Japan (JP), Switzerland (CH), France (FR), United Kingdom (UK), Italy (IT), Austria (OE), Denmark (DK), Spain (ES). **Source:** Deutsche Bundesbank database. Subsample of non-financial firms.

As has been found for US data, most of the FDI is wholly-owned. In 2002, for example, almost 70% of the directly held subsidiaries had only one foreign investor. Figure 1 shows how the total assets of the affiliates can be attributed to investors from different countries. Allthough the investors of German inbound FDI are rather unevenly spread out across investing countries, there remains a rather large number of investments coming from smaller countries. Figure 1 shows a dominance of US investors, which has seemingly declined during the 1990s. This may be partly due, however, to the increased use of (often Dutch) intermediate holdings (cf. also Desai, Foley and Hines 2003b, Mintz 2003).

Table 1. Descriptive statistics, aggregated sample (2001)

	Direct		Indirect	
Balance sheet item	Total (billion)	Fraction of balance sheet	Total (billion)	Fraction of balance sheet
Paid-up capital	19.200	10.6945	20.600	8.7026
Capital reserves	39.400	21.9686	28.400	11.9889
Surplus reserves	2.151	1.1991	6.498	2.7394
Profit/loss carry-forward	-10.900	-6.0962	-2.459	-1.0367
Current profits	-1.515	-0.8447	1.424	0.6003
Debt	94.300	52.5342	126.000	53.1273
Liabilities to affiliated companies	47.200	26.3162	75.900	32.0105
in Germany	11.300	6.3081	58.800	24.8007
outside Germany	35.000	19.5071	15.400	6.4763
Other liabilities	36.900	20.5447	56.600	23.8784
Balance sheet total	179.000	1	237.000	1

Let us now turn to the financial structure. Table 1 gives the crude picture. In 2001 the balance sheet total of directly held firms amounted to €179 billion.[6] About 11% of this was financed by paid-up capital and some 23% consisted of retained earnings from previous periods (capital and surplus reserves). On aggregate, loss carry-forwards amounted to roughly 6%. Debt and other liabilities made up for roughly 73% of the aggregated balance sheets. The financing pattern changes when we turn to indirectly held firms, i.e. corporations that are not directly held by a foreign company but held via an intermediate company located within Germany. The two types of firms differ with respect to the capital reserves, the loss carry-forwards and the liabilities to affiliated companies. While overall debt makes up for roughly 53% of the balance sheets in both cases, indirectly held firms tend to owe more to affiliated companies. Moreover, the structure of these liabilities differs between the two types of firms. Indirectly held firms tend to owe most of this (25% of the balance sheet) to affiliate companies within Germany and directly held firms owe most of it (20%) to affiliated firms outside Germany. This reflects the fact that indirectly held firms are owned by *German*

[6] Due to an increase in the thresholds for the reporting requirement, the year 2001 is somewhat more representative for our data than the year 2002.

intermediate companies that can act as financial clearing institutions for their subsidiaries. Conversely, directly held subsidiaries are held by a foreign firm or foreign holding company and are less likely to face an affiliated company in Germany. By international standards, the amount of cross-country intra-company debt looks large. For comparison, Desai, Foley, and Hines (2003a) report that US-owned foreign affiliates, on a worldwide average, finance 8% of their total assets by borrowing from their US parent. Similarly, Altshuler and Grubert (2003) report for a sample of 5,981 US-owned non-financial subsidiaries that loans from stockholders amounted to roughly 10% of total assets in 1996. German non-financial FDI abroad is also financed by intra-company loans to a much lesser extent. In 2001 the liabilities of those firms to German affiliates (including their German parent) amounted to some 8.7% of the balance sheet total and the liabilities to non-German affiliates were 8.3%.

The summary statistics of Table 1 do not, of course, reflect the possibly large heterogeneity in the data across firms and across investor countries. Therefore, Figure 2 gives some information on firm heterogeneity. Each of the 12 graphs (6 for direct and 6 for indirect participations) contains 5 lines. The bold line represents the respective financing ratio of the median firm, i.e. 50% of the firms have a lower financing ratio. The other curves represent the financing ratios for the 5%, 25%, 75% and 95% centile firms.

Several features are remarkable. As shown in the first graph of Figure 2, after the year 1996 more than 5% of the firms had paid-up capital that amounted to more than 100% of total assets. Technically, this is possible if there are negative items on the liability side of the balance sheet such as loss carry-forwards or current losses.

Figure 2. Diversity in financial ratios

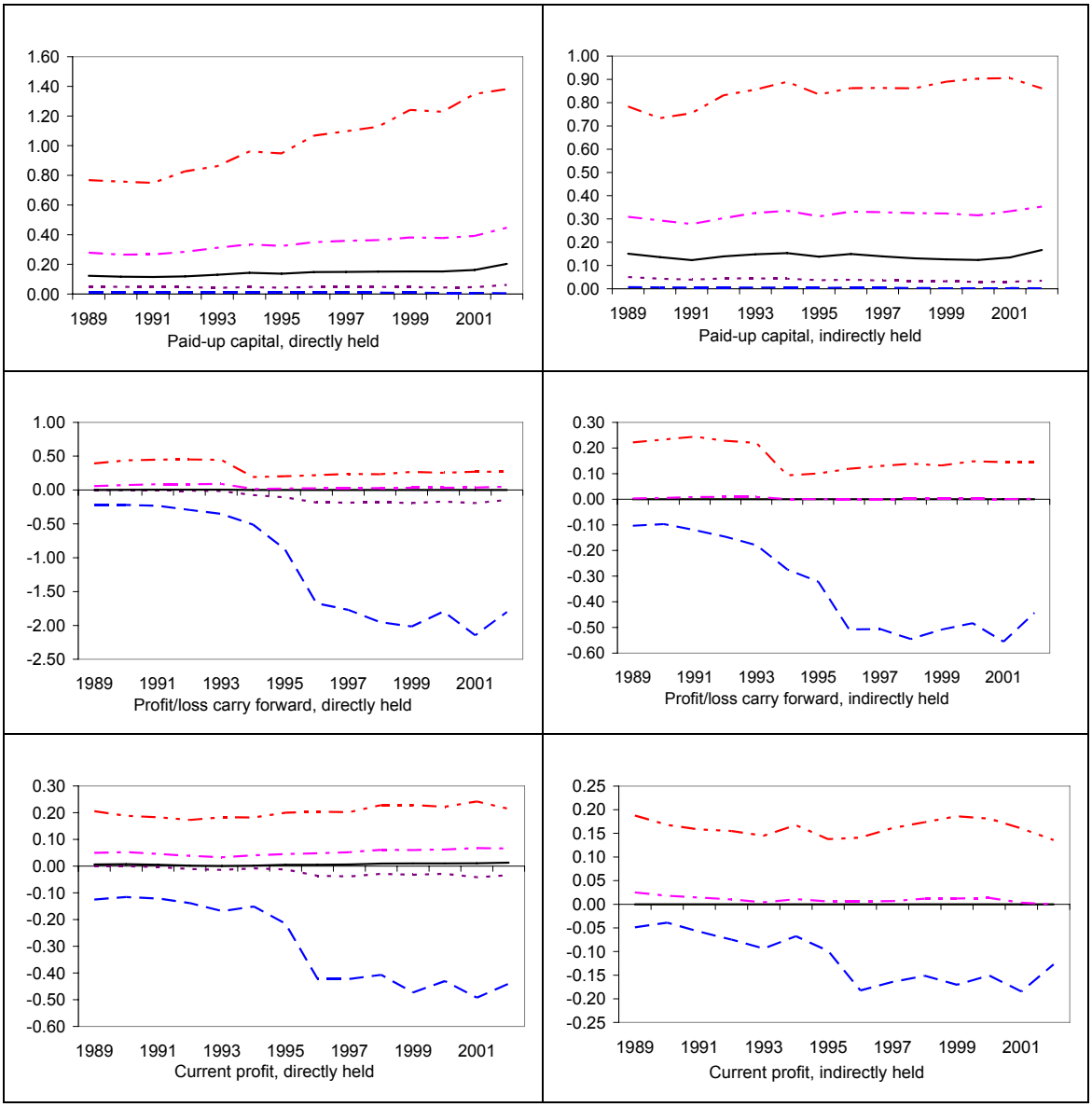
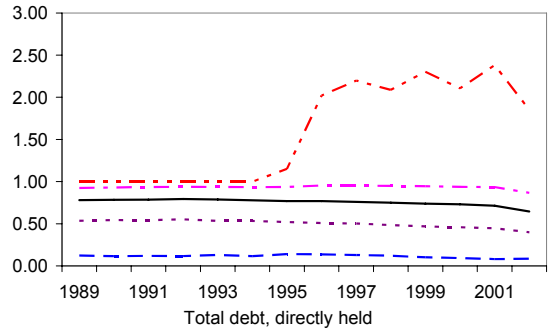
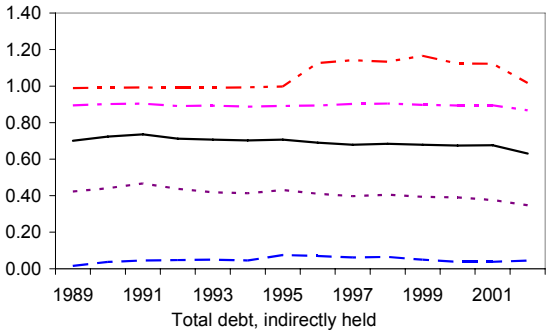
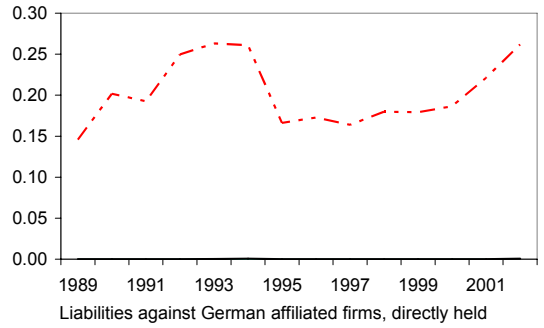
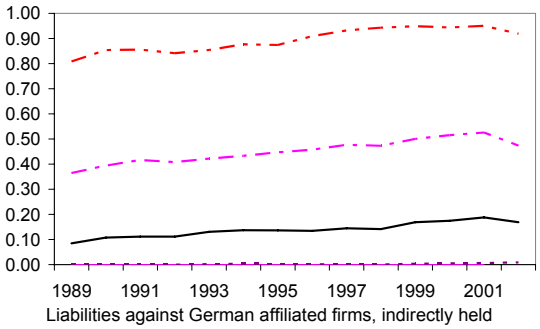


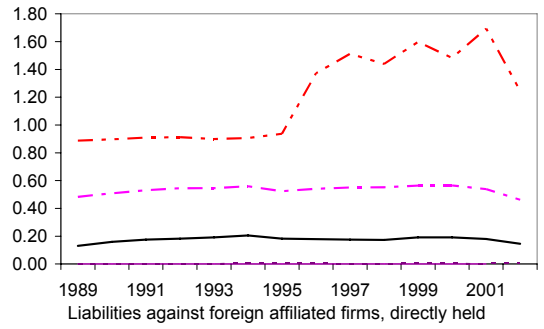
Figure 2 cont'd

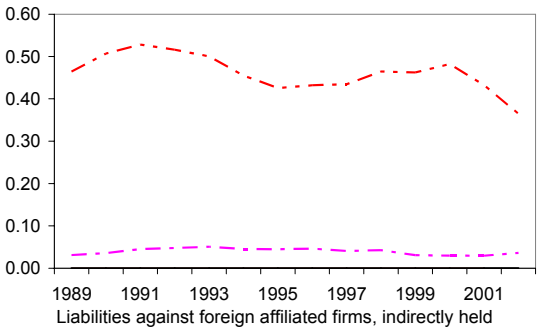












Annotation: In each graph, the bold line indicates the respective financial ratio of the median firm. The two lines below the median line characterise the financial ratio of the 5th and 25th centile firms, the two lines above the median ratio indicate the 75th and 95th centiles. Each of the left hand diagrams refers to the subsample of firms that are directly held by a foreign firm, while the graphs on the right hand refer to firms in Germany that are foreign held via a German company.

Indeed, from 1993 onwards, directly held affiliates experienced growing loss carry-forwards. The value of a firm that represents the fifth centile in terms of this balance sheet item has doubled from 1995 to 2002 and amounted to 180% of the balance sheet total at the end of the period, implying negative equity. For 5% of the

indirectly held firms loss carry-forwards still exceeded 44% of the balance sheet. From 1993, extreme outliers are present also when we consider current net-of-tax profits of directly and indirectly held firms. In 1995, 5% of the directly held affiliates had a current loss that exceeded 21% of their balance sheet and, by the year 2002, 5% of the firms had a yearly loss that amounted to at least 44% of their balance sheet total. In the case of indirectly held affiliates, losses for the fifth centile reached 10% of the balance sheet total in 1995 and 13% in 2001. It should be noted that a growing number of firms are running huge losses in consecutive years. While the huge number of unprofitable operations is surprising, it is also remarkable that a large number of firms report exactly zero net-of-tax profits and this holds true for the median directly and indirectly held firms in almost any year from 1989 to 2001.

Turning to total debt, in recent years 5% of the directly held affiliates have had a share of debt in balance sheet total that exceeded unity. As with paid-up capital, this is possible in the case of negative current profits and/or negative profit carry-forwards. Finally, for at least 5% of the directly held subsidiaries liabilities to affiliated firms outside Germany account for more than 100% of the balance sheet total after 1995. For the fifth centile, the fraction is growing and was 1.24 in 2002. Interestingly, the development of the internal debt in this centile closely corresponds to the development of losses for the fifth centile. Quite obviously, for some firms current losses are covered by intra-company loans instead of new equity.

To sum up the above description, in the second half of the 1990s the financial structure of a sizeable fraction of the inward FDI projects in Germany was strongly influenced by large losses and this holds particularly for directly held firms. In many cases losses were accumulating over time and to some extent intra-company loans were used to finance these losses. While corporate losses seem to play a huge role in explaining the financial structures of some firms, the next sections will analyse what role is left for tax differences between Germany and the home country of the investor. Before we will do so, however, we will briefly introduce our tax rate data.

Figure 3 gives an impression of the distribution of DIFF, as defined in section 2, for the full sample of all directly and indirectly held affiliates in our data set with all

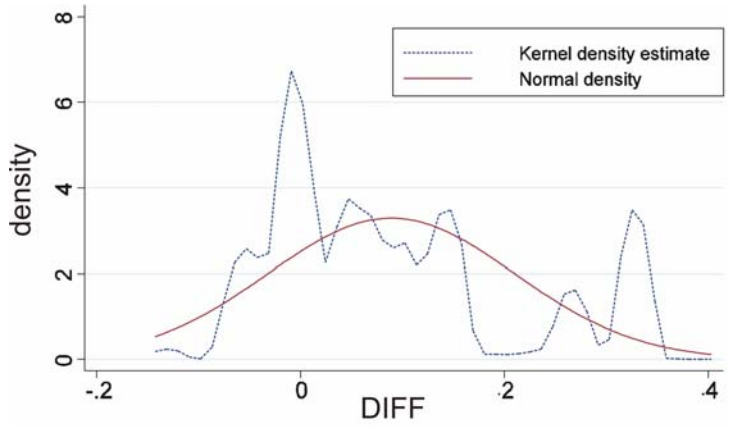
years pooled.[7] The data set contains tax information from up to 69 countries and digests information on the foreign corporate taxes including average local taxes, the German withholding tax on dividends and the German corporate tax (including average local taxes) against which firms can deduct interest expenses.[8] The tax rates were collected by using various publications of PricewaterhouseCoopers, KPMG, Ernst & Young, and the database of the Office of Tax Policy Research at the University of Michigan.[9] To calculate the tax rate on distributed earnings τ_d^* we had to identify the relevant withholding tax rates on dividends and the tax system in the parent's home country (exemption or credit system). In the case of an exemption system, τ_d^* equals the German rate on distributed profits plus the applicable withholding rate on dividends. If the home country of the parent uses a credit system of taxation and its tax rate exceeds the effective German rate on distributions, then we set τ_d^* to equal the home country tax rate. In cases, in which a German firm is owned by several investors from foreign countries, we use average values of DIFF, with the fractions of the ownership stakes taken as weights. Rather than showing the histogram itself, Figure 3 gives a Kernel density estimate, which makes it somewhat easier to compare the distribution with a normal distribution. For a very large share of the observations DIFF is positive implying that for tax reasons it pays for a profitable multinational to substitute intra-company debt for equity (i.e. to distribute retained earnings). But owing to the German split rate system of the corporate tax with its smaller rate on distributed profits and the limited tax deductibility of interest against the local taxes for some countries during the 1990s, DIFF was (partly) negative. Italy and Japan are examples. When we look at the time variation in the tax rate data, 62 per cent of the home countries in our sample did experience corporate tax rate changes during the period 1996-2002 and the average standard deviation of the national corporate tax rate is some two percentage points.

[7] In those cases where the affiliate is owned by foreign investors from more than one country we calculate DIFF as a weighted average of the individual country values (weights taken from the ownership of shares).

[8] In selected cases, we decided to depart from headline corporate taxes in investor countries due to special regimes. For example, a huge fraction of German subsidiaries is held via Dutch holdings. Since 1997, these holding can allocate 80 per cent of their interest income to special provisions, which in effect exempts 80 per cent of the income. Therefore we adjusted the Dutch tax rate accordingly.

[9] We are grateful to Jack Mintz for joint efforts in accomplishing this.

Figure 3. The distribution of DIFF0



4 Empirical Evidence

The role of taxes on the financial structure has been widely analysed in empirical studies, but most studies are concerned with national firms and national tax systems.[10] While the older literature has generally failed to find significant effects on corporate financing, recent studies of national firms have been more successful in identifying tax effects. MacKie–Mason (1990) looks at the marginal source of finance as a function of the corporate tax rate by looking at the loss carry-forward position of firms. For firms with high loss carry-forwards the tax deductibility of interest has a lower value than for profitable firms. MacKie–Mason shows for a sample of US corporations that firms with high loss carry-forwards indeed use less debt at the margin. Givoly *et al* (1992) use a similar method and use the natural experiment of the US 1986 tax reform act. Gentry (1994) compares US firms that operate in special industries and can avoid the double taxation under the US corporate tax system with other firms that are subject to double taxation of corporate profits. Indeed the first group of corporations shows a significantly different financing behaviour. Graham (1999) argues that empirically the tax rate of the personal investor plays a role in corporate financing decisions. Gordon and Lee (1999) exploit the fact that in the US smaller corporations are granted a lower corporate tax rate and find a significant effect of this lower rate. Finally, Gropp (2002) shows a sizeable

[10] There is a huge theoretical literature on the determinants of the financial structure of corporations. A useful survey of this literature is given in Harris and Raviv (1991).

tax effect on the financing of marginal corporate investment by exploiting local tax differentials for German firms.

So far, there is rather limited evidence on the empirical effects of international taxation on the financing of multinationals. Three notable exceptions have been described in the introduction, and all of them identify effects for US-owned subsidiaries.

In this study we want to address the question of how tax rate differences between the home country of an investor and Germany influence the financial structure of German inward FDI. Therefore, the endogenous variable that is of foremost interest to us is the amount of intra-company loans granted to a German affiliate by its foreign investor divided by the balance sheet total (LIABOUTGER). As we cannot exactly distinguish from which country a loan is granted we employ the working hypothesis that all debt from non-German affiliated companies comes from the parent and the applicable tax rates for this country are taken into account.

Table 2 summarises our findings for the liabilities to non-German affiliated companies (cross-border intra-company loans). Since the Breusch-Pagan and the Hausman tests reject the use of random-effects models, we report only the results for fixed-effects models. Because of the quite different importance of cross-border intra-company loans for directly and indirectly held affiliates we analyse them in separate subsamples. Columns (1) and (2) report the results for a model in which the variable DIFF summarizes the tax incentives to borrow from the parent. From section 2, we should expect that DIFF is positively correlated with the amount in intra-company loans. The model behind columns (3) and (4) splits up the effects of the foreign tax rate and the German tax rate. A larger foreign tax rate should lead to heavier taxation of interest paid by the affiliate and should make cross-border loans less attractive. We therefore expect a negative coefficient. Conversely, the higher the German rate, the higher is the value of interest deductions and the more cross-border loans should be expected. The problem here is that the German statutory tax rate is the same for all firms in our sample. In a model with fixed time effects the respective coefficient therefore cannot be identified. To overcome this problem we split our sample into a subsample of firms that on average show a positive profitability and into a second

subsample of firms that have zero or negative average profitability across observations. A dummy PROFIT takes on the value one for a firm in the first subsample and the value zero, otherwise.[11] The variable GERTAX is the product of this dummy and the German corporate tax rate as it is relevant for interest deductions. As has been argued in section 2, profitable (i.e. taxable) firms can be expected to react more strongly with their leverage decision upon a German tax rate change. Therefore we expect a positive coefficient of the variable GERTAX, which also has a sizeable variation over the years since the German tax rate relevant for interest deductions has come down from 59.65% in 1996 to 33.07% in 2002.

Table 2. Determinants of cross-border intra-company loans

	(1) Directly held affiliates	(2) Indirectly held affiliates	(3) Directly held affiliates	(4) Indirectly held affiliates
DIFF	-0.024	0.021		
	(0.016)	(0.008)***		
CT			0.003	-0.007
			(0.014)	(0.011)
GERTAX			0.137	-0.014
			(0.054)**	(0.007)**
PROFITABILITY	-0.302	-0.073	-0.293	-0.062
	(0.033)***	(0.025)***	(0.033)***	(0.027)**
SIZE	0.053	0.001	0.054	0.001
	(0.006)***	(0.001)	(0.006)***	(0.001)
COLLATERAL	-0.066	-0.066	-0.064	-0.065
	(0.018)***	(0.012)***	(0.018)***	(0.012)***
Observations	25,540	15,090	25,821	15,318
Number of firms	4,985	3,314	4,985	3,314
R-squared	0.79	0.48	0.78	0.48

Notes: Dependent variable: liabilities to affiliated companies outside Germany over the balance sheet total. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Unbalanced sample for the years from 1996 to 2002. Firm fixed-effects (within) estimator. Standard errors are corrected for clustering across country observations and for heteroscedasticity. A full set of time dummies has been used; coefficient estimates are not reported. We eliminated outliers by excluding observations for which the exogenous variables PROFITABILITY, COLLATERAL and SIZE were either in their two lowest or in their two highest percentiles. We also excluded firms that on average across all observations had a debt to asset ratio of unity or larger. To be included observations had to be consecutive for at least three years. Total assets are used on both sides of the equation in the denominators of LIABOUTGER, COLLATERAL and PROFITABILITY. Since this poses potential endogeneity problems, we also used instrumental variables approaches (using a GMM model) but the test statistics always rejected the validity of the available instruments. Therefore the GMM results are not reported.

[11] For 68 per cent (42 per cent) of the directly (indirectly) held firms in the sample of Table 2, PROFIT takes on the value one.

Columns (1) and (2) use the variable DIFF, columns (3) and (4) use CT and GERTAX. The tax variable DIFF is found to be non-significant for directly held firms in column (1). This result changes if we look at indirectly held firms in column (2). Here the coefficient is significant, but is still economically small. It suggests a .2 percentage point increase in the ratio of cross-border loans to total assets if the home country rate increases by 10 percentage points.

A possible reason for this weak correlation is that a large percentage of the firms in our sample have negative profits in consecutive years. The models in columns (3) and (4) report the results for variables CT and GERTAX and try to overcome this problem. We find that the influence of the parent's home tax rate, CT, is still insignificant for directly and indirectly held affiliates. Turning to the coefficient GERTAX we find a significant and sizeable effect for directly held firms that receive the major part of cross-border intra-company loans. The coefficient implies that an increase of the German tax rate of 10 percentage points increases the fraction of cross-border loans to balance sheet total by some 1.37 percentages points relative to the control group that on average shows non-positive profitability. While this effect of the host country tax rate is somewhat smaller that identified in studies on US affiliates abroad, it is in the same order of magnitude. Surprisingly, we get a negative sign of GERTAX when analyzing the indirectly held affiliates in column (4). While it is statistically significant, the coefficient for these firms is very small in economic terms and it must be kept in mind that the large majority of these firms do not utilise cross-border intra-company loans (cf. Figure 2).

Drawing on the empirical model of Rajan and Zingales (1995), we add several other variables that may play a role for the financial structure. A large ratio of fixed assets to total assets can be interpreted as a sign for good collateral. This may reduce the agency cost of borrowing and may increase firm value in the event of illiquidity of the firm. This in turn should increase the availability of third-party debt and may reduce the need for loans by the parent. This leads us to introduce the ratio of fixed assets and intangibles to total assets as the explanatory variable COLLATERAL.[12] COLLATERAL has a significantly negative coefficient for all but one subsample

[12] Unfortunately, the Bundesbank data pool fixed assets and intangibles and fixed assets cannot be identified separately.

(profitable indirectly owned affiliates). This is in line with a substitution theory between intra-company debt and third-party debt and the hypothesis that collateral increases the access to third-party debt.

Access to third-party debt may also vary with firm size. If larger corporations are more diversified than smaller ones, the former may have a smaller default risk and better access to outside debt (reducing the need for intra-company debt). But, of course, larger corporations may simply be better equipped with equity and may need less third-party debt as well as less intra-company loans. In any case, size may matter, and we therefore introduce the right-hand variable SIZE, defined as the log of total assets (balance sheet total). The coefficient for size turns out to be insignificant for the sample of indirectly held firms but significantly positive for the directly held affiliates, which may reflect that large, mature firms have a better equity base.

While the significance of the variable GERTAX is evidence that tax considerations do matter for the size of cross-border intra-company loans, this may not be the full story. Indeed, only some 55% of the German affiliates are financed by cross-border intra-company loans. As we have seen from the descriptive statistics, a sizeable fraction of the foreign subsidiaries in Germany run huge losses and intra-company loans seemed to be an important instrument to keep those firms alive. In total, 60% of all cross-border intra-company loans are granted to affiliates that are in a loss position and therefore have a limited benefit from interest deductibility. This alone suggests a strong role of cross-border loans in covering losses. Another piece of evidence for the role of losses is the coefficient of the variable PROFITABILITY in Table 2, which is defined as the ratio of current profits net of taxes to total assets. We find a significant negative and sizeable correlation between PROFITABILITY and cross-border intra-company loans for directly held firms. The marginal effects reported in Table 2 indicate that a reduction in profits of 1% of the balance sheet total leads to additional cross-border loans of .3% of the balance sheet total. While PROFITABILITY is also significant in explaining the intra-company loans for indirectly held firms, the estimated coefficients are much smaller. This reflects the fact that for indirectly held firms a German intermediate company is available to provide short-term finance and cross-border loans are largely redundant.

It should be noted that the coefficient for the variable PROFITABILITY may suffer from an endogeneity problem since our estimation makes use of the profit after interest payment: additional intra-company loans lead to additional interest payments that reduce accounting profits and the right-hand side variable PROFITABILITY. Note that the possible bias should be small, though. If we consider total assets of a firm as given and normalized to unity and introduce the unobserved (after tax) interest rate r, our estimation equation may be re-written as $D_{it} = \beta_0(E_{it} - D_{it} \cdot r) + g_i + h_t + \beta X_{it} + \varepsilon_{it}$, where D is the amount of intra-company loans, E denotes the amount of earnings before interest on these loans, g_i is a firm-fixed effect, h_t is a time fixed effects and X_{it} is a vector of the other regressors. Using the estimated value of β_0, $\hat{\beta}_0$, and differentiating with respect to E and D, the effect of a change of E on D is derived as $\frac{dD}{dE} = \hat{\beta}_0 / (1 + \hat{\beta}_0 \cdot r)$. If we assume a (constant) net of tax interest rate of r = 10%, then the 'true' coefficient for dD/dE was -0.311 rather than the estimated $\hat{\beta}_0$ of -0.302 presented in column (1) of Table 2. Given a lack of economically reasonable and statistically valid instruments for the profit *before* interest we decided to accept the possibility of such a limited bias.

As mentioned in section 2, a close substitute to an intra-company loan is to increase third party debt of the high-tax affiliate in Germany and to reduce third party debt of the parent firm.[13] For parent firms in low-tax jurisdictions (high DIFF) debt is less advantageous from a tax saving perspective and parents may use less leverage. This in turn allows them to increase the leverage in high tax affiliates (like German ones) without unduly increasing the multinational's overall leverage. Unfortunately, we are not in a position to use the balance sheets of parent firms to find additional evidence for such countervailing effects abroad. But as pointed out in section 3, the tax preferences for such a transaction should again be influenced by our variable DIFF and the tax attractiveness of third-party for financing German subsidiaries should be influenced by this variable. We therefore re-ran the regressions presented in table 2, but using third-party debt to balance sheet total as the endogenous variable (Table 3).

[13] For a discussion of similar financing strategies see Altshuler and Grubert (2003).

For the directly held affiliates (column (1)) DIFF has the expected sign and is significant, although the estimated coefficient is small. For indirectly held firms (column (2)) the coefficient turns out to be insignificant. If we instead use the variables CT and GERTAX, these results turn around: now the variable GERTAX has the expected and significant sign for indirectly held affiliates but is insignificant for directly held firms. The home country tax rate CT is insignificant in both cases. Together this provides only limited evidence that tax rates play a major role in the decision to raise outside debt.

Table 3. Determinants of third-party debt

	(1) Directly held affiliates	(2) Indirectly held affiliates	(3) Directly held affiliates	(4) Indirectly held affiliates
DIFF	0.034	0.013		
	(0.014)**	(0.020)		
CT			-0.020	0.035
			(0.014)	(0.025)
GERTAX			0.068	0.036
			(0.043)	(0.018)**
PROFITABILITY	-0.222	-0.120	-0.222	-0.146
	(0.031)***	(0.030)***	(0.030)***	(0.033)***
SIZE	0.034	0.018	0.034	0.018
	(0.009)***	(0.003)***	(0.009)***	(0.003)***
COLLATERAL	0.110	-0.029	0.103	-0.033
	(0.026)***	(0.021)	(0.027)***	(0.020)
Observations	25,339	14,923	25,616	15,143
Number of firms	4,927	3,284	4,927	3,284
R-squared	0.80	0.57	0.80	0.57

Notes: Dependent variable: liabilities to affiliated companies outside Germany over the balance sheet total. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. Unbalanced sample for the years from 1996 to 2002. Firm fixed-effects (within) estimator. Standard errors are corrected for clustering across country observations and for heteroscedasticity. A full set of time dummies has been used; coefficient estimates are not reported. We eliminated outliers by excluding observations for which the exogenous variables PROFITABILITY, COLLATERAL and SIZE were either in their two lowest or in their two highest percentiles. We also excluded observations for which the endogenous variable was in the two highest percentiles. To be included observations had to be consecutive for at least three years.

PROFITABILITY again turns out to have a highly significant influence. The variable SIZE is positively correlated with third-party debt, which suggests that larger firms have better access to third party debt. COLLATERAL is significant and positively correlated with third-party debt in the case of directly held firms but is insignificant for indirectly held affiliates.

5 Discussion

The paper has analysed the financial structure of German inbound FDI in the non-financial sector. On average, some 25% of the balance sheet total of these firms was financed by intra-company loans in 2001 and for affiliates that are directly held by a foreign investor, cross-border intra-company loans account for 20% percent of balance sheet total. Tax rate differentials are frequently named as a possible explanation for this strong role of intra-company loans in financing foreign subsidiaries in Germany. If the interest on the loan is received in a low-tax country but is tax deductible in high-tax Germany, this financial instrument can produce a global tax saving for the multinational, the amount of which decreases in the foreign country's tax rate. Therefore we should expect that cross-border intra-company loans are used more extensively when the parent is located in a low-tax country. Based on a panel of 8,000 firms operating in Germany, we could provide only limited evidence that the home tax rate of the foreign parent is important for the amount of intra-company loans. Possibly, our analysis here suffers from lacking information on whether the foreign parent is in a loss position. In any case, the failure to identify sizeable effects of the home country tax rate does not imply that foreign affiliates that operate in Germany do not use financial strategies to save taxes. Our empirical results have shown that directly held subsidiaries that on average are profitable do react more strongly to the German tax rate than other subsidiaries. This suggests that the size of the German tax rate does play a role for the leverage decision. Considering third-party debt in the hand of Germany-based affiliates our results show a significant effect of the German tax rate when we look at indirectly held affiliates but not when we look at directly held affiliates.

Leverage decisions of foreign subsidiaries are certainly not exclusively steered by tax considerations, although these considerations do seem to play a role. Another important factor of cross-border intra-company loans is (low) profitability. The majority of cross-border intra-company loans are received by loss-making subsidiaries. In our panel analysis we find that for directly held foreign affiliates a reduction in profits by 1% of the balance sheet is associated with an increase of cross-border loans by .3% of balance sheet total. Profitability, besides the different use of cross-border intra-company loans, is another area where directly and indirectly held firms differ starkly. Foreign-owned firms that are held via a German intermediate company show a much lower

variation in profitability than do directly held affiliates and a majority of the indirectly held firms shows virtually zero profitability. Further analysis of these differences may potentially lead to additional insights into the tax avoidance strategies of multinational firms but are left for future research.

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II
The Tax Revenue Implications of Marks & Spencer for Germany

1 Introduction

The European Court of Justice ruling in the Marks & Spencer case (C-443/03) may force EU member countries to allow multinational firms to set foreign losses against domestic taxable profits. That may give rise to considerable tax revenue losses. This paper uses the foreign direct investment database (FDI database) of the Deutsche Bundesbank to calculate potential revenue losses for Germany. For the tax revenue loss, the Deutsche Bundesbank's FDI database shows that a retroactive loss offset for the years 1997-2002 would cause a revenue loss of up to €30 billion, or 1.5 percent of German gross domestic product. That result is based on the assumption that all foreign losses can be set against domestic profits, which requires profits of all parent companies to be sufficiently high. It should therefore be interpreted as an upper boundary for the revenue losses. We also consider the introduction of bordercrossing group relief with subsequent taxation rules. In principle, subsequent taxation may limit the revenue losses caused by border-crossing loss offsets. But our calculations suggest that the revenue that can be raised through subsequent taxation will reduce the revenue losses from border-crossing loss offset by no more than 5 percent to 10 percent. Those numbers should be interpreted taking into account that we have abstracted from behavioral adjustments. If those adjustments are considered, it is likely that the revenue losses in countries with high statutory tax rates will be even higher.

In principle, the EC Treaty grants full sovereignty to member states in direct tax matters. But recently, national tax systems have increasingly been challenged by rulings of the ECJ. Conflicts between nations' tax systems and EC law may arise if national tax rules discriminate against bordercrossing economic activity relative to purely national activity.

The case of U.K.-based retailer Marks & Spencer is a widely discussed example of that type of conflict. In the 1990s, subsidiaries of Marks & Spencer in Germany, Belgium, and France started to suffer considerable losses and ceased trading in 2001.

Marks & Spencer then claimed group relief in the United Kingdom; that is, the firm attempted to set the losses incurred abroad against profits earned in the United Kingdom. U.K. tax authorities rejected that claim on the grounds that U.K. group relief is restricted to domestic subsidiaries. Marks & Spencer challenged that decision before U.K. courts and the High Court of Justice asked the ECJ to clarify whether the U.K. group relief rules are compatible with EC law. It is likely that the ECJ will decide that the restriction of group relief to domestic subsidiaries violates the freedom of establishment in the European internal market.[14]

Because most EU member countries have similar group relief rules, the ECJ decision in Marks & Spencer will affect governments throughout Europe. Most importantly, a decision against the restriction of group relief to domestic subsidiaries would imply that multinational companies in all member states might pursue similar claims against their governments, leading to major tax revenue losses. Moreover, governments may face a significant decline in corporate tax revenue if existing group relief schemes must be extended to EU-wide operations.

Although the budgetary implications of the Marks & Spencer case are a major concern among national policymakers in the European Union, the magnitude of those potential revenue losses is largely unclear. This paper attempts to calculate the revenue losses for Germany using profits and losses of foreign subsidiaries of German multinational firms reported in the FDI database of the Deutsche Bundesbank[15], as discussed above. We restrict our analysis to subsidiaries in the EU 15, that is, those countries that were EU member states before May 1, 2004.[16]

Our analysis focuses on two questions. First, we assess the potential tax claims from foreign losses suffered by German multinational firms in the past. Second, we ask whether tax revenue losses from border-crossing group relief can be limited if deductions due to foreign losses are ‘‘clawed back’’ when the subsidiary sets those losses against profits in a later year. Such a subsequent taxation rule would be

[14] See Advocate General Miguel Poiares's opinion on the Marks & Spencer case, summarized in ECJ release 29/05 from April 7, 2005. Our analysis does not investigate the revenue implications of this more restrictive type of loss offset rule. The final decision of the ECJ will clarify whether such a limitation of border-crossing loss offset would be compatible with EC law.
[15] A detailed description of this dataset give Lipponer (2003).
[16] For the juridical aspects see Schön (2004).

compatible with EC law and would prevent bordercrossing loss offsets from creating ‘‘double or multiple dip’’ opportunities, when loss offsets are effectively used more than once.

The rest of the paper is set up as follows. In the first section, we describe how the volume and the profitability of German foreign direct investment in the European Union have developed since 1989. In the second section, we calculate the tax revenue losses that would arise if German firms were allowed to set their foreign losses incurred in the past against domestic profits. Section III investigates the effect of introducing subsequent taxation rules on tax revenue. Section IV provides a conclusion.

2 German Foreign Direct Investment In the European Union

The budgetary implications of border-crossing loss offset will only be significant if the amount of foreign direct investment of German firms in other EU countries is sufficiently large. Table 1 reports how the stock of foreign direct investment of German firms in the European Union has developed since 1989. German outbound FDI can be found in all EU member states. The stock of foreign direct investment increased considerably between 1989 and 2001 and declined slightly in 2002.

Table 1. German FDI Positions in the EU (in billions of euros)

	1989	1990	1991	1992	1993	1994	1995
Benelux	12.7	15.8	19.2	23.7	25.7	27.5	30.0
France	8.1	9.2	10.5	11.6	11.9	12.7	14.0
UK	6.2	7.7	8.2	8.1	9.1	12.1	17.0
Italy	4.6	5.4	6.4	5.9	6.1	6.4	7.4
Ireland	0.9	2.9	5.3	6.3	6.9	6.6	7.4
Austria	2.7	3.1	3.6	4.3	4.8	5.4	5.5
Poland	0.0	0.0	0.0	0.1	0.3	0.5	0.8
EU10	0.1	0.2	0.3	0.7	2.3	3.2	4.5
EU15	42.1	52.4	62.9	69.3	73.4	80.9	92.4
EU25	42.1	52.5	63.2	70.0	75.7	84.1	96.9

	1996	1997	1998	1999	2000	2001	2002
Benelux	31.7	36.8	36.5	47.5	68.1	74.9	78.1
France	15.9	16.5	20.6	20.9	29.6	38.2	38.2
UK	20.4	25.4	26.4	35.5	49.2	55.3	54.1
Italy	9.1	10.4	12.0	13.6	16.5	16.5	18.4
Ireland	7.5	7.7	7.3	8.3	6.1	6.6	6.8
Austria	5.9	6.7	8.5	9.1	15.2	15.2	15.5
Poland	1.4	2.4	3.7	4.9	6.9	8.5	7.9
EU10	7.3	9.4	12.4	15.8	21.8	25.5	28.1
EU15	103.1	117.8	128.4	157.9	209.9	234.1	241.9
EU25	110.4	127.2	140.8	173.8	231.7	259.5	270.0

That decline may reflect the economic downturn that occurred in that year, which is also likely to have reduced foreign direct investment. Moreover, the year 2002 is the first year that the selection criteria for the foreign direct investment statistic was changed and smaller projects were excluded from the FDI database, which may also partly explain the decline in the numbers. In 2002, the stock of foreign direct investment in the European Union was €241 billion.[17] Table 1 also reports the numbers for some major EU member states and the aggregate values for the new member countries (EU 10) and the entire European Union (EU 25).[18]

How large were the profits and losses incurred by foreign subsidiaries of German multinational firms in the period under consideration? Table 2 reports the aggregate profits and losses for the period between 1989 and 2002.[19]

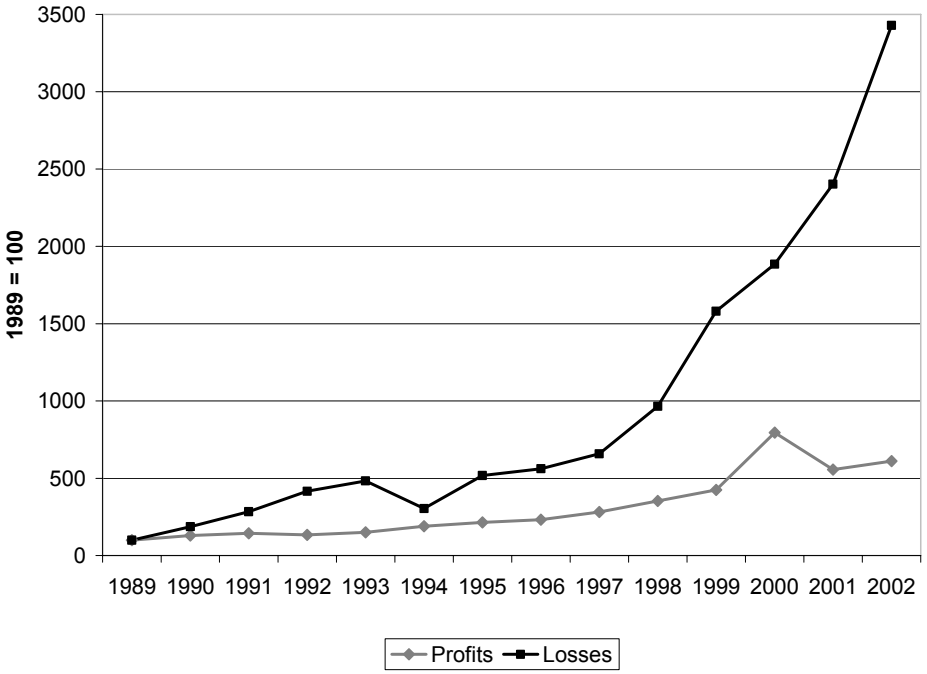
Table 2. Profits and Losses of German FDI in the EU (in millions of euros)

	Profits	Loses
1989	5439,5	-888,2
1990	7023,4	-1657,0
1991	7858,0	-2522,9
1992	7264,5	-3694,1
1993	8196,3	-4290,6
1994	10265,4	-2704,9
1995	11704,1	-4596,0
1996	12,565.3	-4,989.3
1997	15,325.6	-5,850.8
1998	19,165.3	-8,567.5
1999	23,089.8	-14,044.7
2000	43,259.4	-16,743.3
2001	30,251.4	-21,340.5
2002	33,207.3	-30,466.6

It turns out that both profits and losses have increased considerably over time. But it is striking to note that losses have increased much faster than profits. Figure 1 demonstrates that by normalizing the values of the year 1989 to 100, the increase of losses is much higher than the growth of profits in the same period.

[17] The attribute ‘‘German’’ refers to firms residing in Germany. That includes firms in foreign ownership.
[18] EU 15 refers to countries that were members of the European Union before May 1, 2004. EU 10 refers to the countries that joined the European Union in 2004 and EU 25 refers to the current European Union.
[19] The numbers in Table 2 include 100 percent of the losses, even if the share held by the German parent firm is smaller. Most subsidiaries in the data set are fully owned by the German parent company. In the calculations in Table 4, the ownership share is taken into account.

Figure 1. Profits and Losses of German FDI in the EU (with 1989=100)



We may thus state that German foreign direct investment has generated considerable losses during the last decade. Surprisingly, the increase in losses has been much larger than the growth in profits even though foreign direct investment is usually perceived to be a highly profitable activity. Our findings also seem to be inconsistent with the widespread view that German firms use transfer pricing to shift profits to other countries because the statutory tax rate on corporate profits in Germany is higher than in most other countries.[20]

3 Implications for Tax Revenue

The effects of foreign loss offsets on domestic tax revenue depend, among other things, on the profit situation of the parent company. If the parent company suffers losses from domestic activities as well, foreign loss offsets have no immediate budgetary impact. But if the parent company earns profits in later years, foreign losses will eventually be used as a tax shield and thus reduce domestic tax payments. In our data set, only part of the subsidiaries can be matched to domestic parent companies. As a working hypothesis, we therefore assume that foreign losses can always be set against

[20] See Bond (2000)

domestic taxable profits in the same period. We thus calculate an upper boundary for the potential revenue losses.

Apart from the profit or loss position of the parent company, the revenue effect of border-crossing loss offsets depends on whether losses set against domestic profits will be subject to subsequent taxation if the foreign subsidiary sets those losses against foreign profits in a later year. As a first step, we abstract from the possibility of subsequent taxation.

The yearly tax revenue losses from bordercrossing loss offsets may now be calculated simply by multiplying the overall foreign losses with the German statutory corporate income tax rate (Körperschaftsteuer), including surcharges. We do not take into account the German local trade tax (Gewerbesteuer) because it is not clear whether that tax will also be subject to the ECJ ruling. The results are given in Table 3. For instance, in the year 2000, border-crossing loss offsets would have reduced corporate tax revenue by approximately €7 billion, which is equivalent to roughly one-third of overall corporate tax revenue in that year. If claims based on foreign losses incurred in the past go back to losses incurred in 1998 or later, the potential revenue losses add up to approximately €30 billion, or 1.5 percent of GDP.

Table 3. Losses in Corporate Tax Revenue Assuming Complete Loss Offset (in millions of euros)

Year	Tax Rate	Losses	Loss in Tax Revenue
1989	56.00%	888.2	497.37
1990	50.00%	1,657.0	828.52
1991	53.75%	2,522.9	1,356.09
1992	53.75%	3,694.1	1,985.57
1993	53.75%	4,290.6	2,306.22
1994	48.38%	2,704.9	1,308.48
1995	48.38%	4,596.0	2,223.31
1996	48.38%	4,989.3	2,413.59
1997	48.38%	5,850.8	2,830.30
1998	47.48%	8,567.5	4,067.41
1999	42.20%	14,044.7	5,926.88
2000	42.20%	16,743.3	7,065.68
2001	26.38%	21,340.5	5,628.57
2002	26.38%	30,466.6	8,035.57

Those numbers show that a retroactive bordercrossing loss offset imposed by the ECJ ruling in the Marks & Spencer case is likely to have dramatic consequences for the government budget in Germany. However, the numbers reported in Table 3 have been calculated assuming that all losses can be offset against domestic profits, so those numbers must be interpreted as a maximum for the possible revenue losses.

4 Tax Revenue Losses Under Subsequent Taxation Rules

One possibility of adjusting group relief to EC law requirements would be to allow border-crossing loss offsets, but to introduce subsequent taxation for foreign losses if those losses are set against foreign profits at a later date. That would not only avoid the possibility of double-dip or multiple-dip strategies (that is, the possibility that losses are deducted more than once), it would also limit the decline in tax revenue to be expected from border-crossing loss offsets in the future. The revenue effects of subsequent taxation will depend on the prevailing pattern of profits and losses in foreign direct investment projects. If the typical investment project first suffers losses and later generates profits, the tax revenue losses for the home country of the parent company due to foreign loss offsets will be small. If, in contrast, the typical pattern is one in which projects are either profitable very quickly or generate losses and cease trade, subsequent taxation rules would not prevent tax revenue losses. As in the preceding section, we assume that the profits of the parent company are always sufficiently high, so that foreign losses can be set against domestic profits. The difference from the preceding section is that those losses are subject to subsequent taxation if the foreign subsidiary later makes profits. For those calculations we need panel data because we must identify the profit and loss positions of individual foreign subsidiaries across time. Our data set allows us to do so only from 1997 on.

In Table 4, the first column reports losses of foreign subsidiaries that have been set against domestic profits, but have not yet been subject to subsequent taxation. The second column reports losses that have been subject to subsequent taxation. The revenue raised is given in the third column.

Table 4. Revenue Effects of Subsequent Taxation (in millions of euros)

Year	Potential subsequent taxation	Losses subject to subsequent taxation	Revenue from subsequent taxation
1997	-7,867.65	841.74	407.19
1998	-13,466.23	863.78	410.08
1999	-23,258.37	1,371.78	578.89
2000	-29,719.48	1,509.15	636.86
2001	-42,760.39	1,895.97	500.06
2002	-61,849.31	2,801.31	738.84

It turns out that the revenue raised through subsequent taxation is between 5 percent and 10 percent of revenue lost from border-crossing loss offsets. Therefore losses that can be set against domestic profits are much higher than subsequent profits. Those findings suggest that the introduction of subsequent taxation will not prevent huge revenue losses from border-crossing loss offsets. It should be taken into account that those results have been derived by abstracting from behavioral adjustments. It is clear that behavioral adjustments will further reduce the potential of subsequent taxation to raise revenue, at least in countries with high statutory tax rates. Parent companies with subsidiaries that have accumulated large losses in the past will try to avoid that subsequent profits will occur in the same firm.

5 Conclusion

The ECJ ruling in the Marks & Spencer case may force EU member countries to allow multinational firms to set foreign losses against domestic taxable profits. Many governments fear that this may give rise to considerable tax revenue losses. For Germany, our calculations suggest that the revenue losses may be as high as €30 billion, or 1.5 percent of German GDP, for the years 1998-2002. However, the reader should take into account our assumption that all foreign losses can be set against domestic profits, which requires profits of all parent companies to be sufficiently high. We have thus calculated what should be interpreted as an upper boundary for the revenue losses. Further revenue losses can be expected for the future, depending on how the EU member countries adjust their group relief rules to EC law. The introduction of border-crossing group relief with subsequent taxation rules may reduce the revenue losses,

relative to a situation without subsequent taxation. But the calculations for our data set suggest that the revenue that can be raised will reduce the revenue losses from border-crossing loss offsets by no more than 5 percent to 10 percent. Those numbers should be interpreted taking into account that we have abstracted from behavioural adjustments. If those adjustments are taken into account, it is clear that the revenue losses in countries with high statutory tax rates will be even higher.

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III
How would formula apportionment in the EU affect the distribution and the size of the corporate tax base? An analysis based on German multinationals

1 Introduction

For decades, proposals to coordinate corporate income taxes in the European Union (EU) have been largely unsuccessful because the member countries refused to give up national sovereignty in the field of direct taxation. But recently, at an informal ECOFIN meeting in September 2004, the finance ministers of the EU countries supported the creation of a working group dealing with corporate tax base harmonisation. Since November 2004 the so called Common Consolidated Corporate Tax Base Working Group has started to investigate concepts for introducing a common European tax base.

The most likely reason for this policy shift is that national governments in the EU find it increasingly difficult to tax the income of multinational corporations (MNC) in a satisfactory way. Next to the pressures implied by tax competition for real investment, countries with high tax rates increasingly observe that profits generated domestically are shifted to low tax jurisdictions through transfer pricing, thin capitalization and other income shifting techniques.[21] For some time, national governments tried to tackle this problem via anti tax avoidance legislation. But this legislation is increasingly challenged by the European Court of Justice (ECJ).[22] The fading power to tax at the national level may have induced governments to give up resistance against tax coordination at the European level.

In its 2001 report on company taxation in the internal market, the EU commission proposed the introduction of a common European tax base which would be apportioned to the member states according to a formula which is yet to be specified.[23] Such an EU

[21] For a survey on the tax competition literature see Fuest, Huber and Mintz (2005). A survey on the empirical literature on tax competition can be found in De Mooij and Ederveen (2003). Desai, Hines and Foley (2003) survey different studies that show empirical evidence for profit shifting. One should note that also losses could be shifted from low tax to high tax countries in order to reduce the tax burden.
[22] See Persoff (2004) for a survey on the relevant ECJ rulings.
[23] For a more detailed analysis of the advantages and shortcomings of formula apportionment

tax base would replace the separate accounting (SA) system for MNC.[24] While the tax base would be harmonized, the EU member countries would retain the right to set tax rates. Each country would apply the national tax rate to its share of the common tax base.

An important problem that policy makers face when proposing changes to the national tax system is to estimate the tax revenue effects. For purely national tax reforms, sophisticated methods and data sources are available to estimate the revenue effects. But for an EU wide reform of company taxation, the available information on the revenue effects for the different member countries is rather limited.

The goal of this paper is to shed some light on the possible revenue effects of an EU tax base with formula apportionment (FA).[25] We focus on the change of the overall tax base and the redistribution of tax bases between countries implied by a switch from SA to FA. Our analysis is based on German firm-level FDI data in combination with balance sheet information on the parent companies. Since German companies with foreign subsidiaries are legally obliged to report the balance sheet positions of subsidiaries to Deutsche Bundesbank, information on foreign profits, losses, property and sales is available. In principle, it would of course be desirable to use data from EU-wide and not just German MNCs. The problem is that, to the best of our knowledge, no EU wide data base of comparable quality is available.[26] Moreover, as we show in greater detail in section 2, German foreign direct investment does constitute a significant part of overall foreign direct investment in the EU. Nevertheless, it is clear that the limitations of our database have to be taken into account when interpreting our results.

The data is used to estimate the firm-level apportionment factors and the SA and FA tax bases for our sample of German multinational companies and their subsidiaries. Our simulation of the FA system proceeds in two steps. In the first step we only

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see Mintz and Weiner (2003).

[24] The proposals discussed at the moment would allow companies to choose between the existing system and the EU tax base.

[25] The term "formula apportionment" is common in the United States, while the term "formula allocation" is mainly used in Canada. Some authors also use "formulary apportionment". We will use the U.S. term formula apportionment here.

[26] Note e.g. that 50% of the data we use is taken from income tax statements whereas most other available datasets are based on financial statements. The data is described in greater detail in section 2.

apportion the profits according to the formula but do not allow for border crossing loss offset. In the second step we add an EU-wide loss-offset.[27] This allows us to distinguish the impact of profit distribution according to the formula and the impact of loss offset.

Our analysis yields the following main results: If an FA system without border crossing loss-offset is introduced, many smaller countries, in particular those which are usually considered to attract book profits under the current system, tend to lose part of their tax base. At the same time, the tax base of large countries increases or at least remains the same, compared to the SA case. Adding border crossing loss-offset to the FA system implies that most lose tax base. This happens because the EU wide corporate tax base declines. In our sample this reduction amounts to about 20 percent.[28]

The result for the decline in the aggregate tax base should be interpreted with caution. This is not only because we only use data on German MNCs, which are unlikely to be representative of the EU as a whole. In our sample period (1996-2001) subsidiaries of German firms in other European countries experienced large losses, so that average profitability was relatively low.[29] These losses are also a reason for the tax base decrease when introducing an EU-wide tax base with loss-offset. It cannot be excluded that losses would be smaller if a longer period had been available.

In the literature, formula apportionment has been studied in both empirical and theoretical contributions. But, as far as we know, this paper is the first attempt to investigate the revenue effects of introducing FA in Europe. Shackelford and Slemrod (1998) discuss the revenue effect of a unilateral introduction of international formula apportionment at the federal level in the U.S. They find that the tax liabilities of US multinationals would increase with the introduction of FA in the USA. The difference to our analysis is that Shackelford and Slemrod (1998) do not allow for international loss-offset.

[27] For theoretical analysis of the effects of an international loss-offset see Gérard and Weiner (2003).
[28] Note that the tax base change is the same as the tax revenue change if we assume that the tax rates remain unchanged.
[29] See Weichenrieder and Ramb (2004).

We will not discus the theoretical arguments for and against the introduction of a common tax base with an FA system at length.[30] The main arguments in favour of such a system are the avoidance of transfer pricing rules,[31] the reduction of compliance costs and the simplification of tax rules for MNC.[32] The idea is that this might foster economic development in the European Union. This argument is put forward by the European Union itself and some researchers in this field.[33] On the other hand there are contributions that emphasize the role of incentives to avoid taxation and distortions in economic decisions of companies when using formula apportionment, which are not present in the current systems of separate accounting.[34]

The paper proceeds as follows. In Section 2 the database used in our estimations is presented and discussed. Section 3 describes the benchmark case with SA, and gives the estimations for the tax bases when SA is in place. Section 4 presents the characteristics of an EU tax base, while Section 5 presents the apportionment system that allocates a common tax base to the EU member countries. In Section 6 the estimation for an EU tax base is presented and compared to the results from Section 3. Section 7 concludes the paper.

2 Data

The most important prerequisite when estimating tax base effects is to find a representative database that contains the necessary information on corporate multinational companies. The calculation of the tax base effects when introducing a single European corporate tax base would ideally use data on all EU multinational companies and their foreign affiliates in Europe in order to generate precise and robust results. Unfortunately, a database that combines the information of parent companies from different EU countries and their foreign subsidiaries does not exist in Europe. Even on the national level most countries do not have information about domestic MNC

[30] There are many contributions to the literature dealing with this issue. See e. g. Gordon and Wilson (1986), Sorensen (2004), Mintz (1999), Weiner (1999), Mintz and Weiner (2003), Devereux (2004), Wellisch (2004) and Pethig and Wagener (2003).
[31] See Riedel and Runkel (2005) for a theoretical analysis of the effect of FA in a union with respect to the transfer pricing activities of companies with subsidiaries in a country outside the union.
[32] The compliance costs of international companies when dealing with the different EU tax systems have been analyzed by the European Commission (2004).
[33] See Mintz (2004) and European Commission (2004).
[34] See Gordon and Wilson (1986).

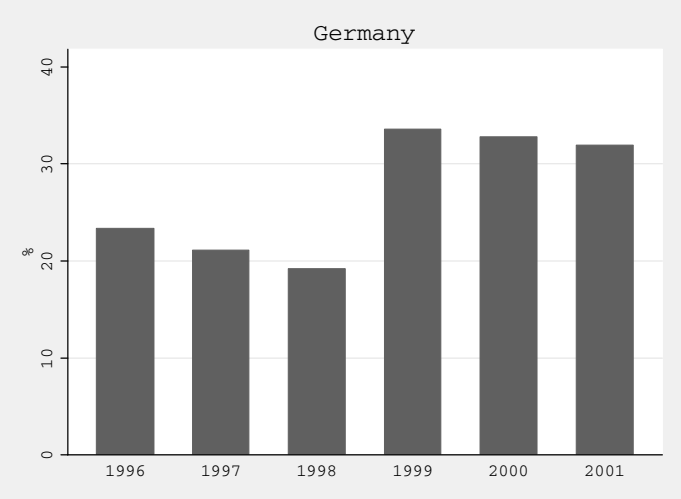
that can be combined with data on the foreign subsidiaries. Our paper is a first step to overcome this data problem. We use German data to create a backward looking database using information on German MNC and their EU subsidiaries.

The Deutsche Bundesbank carries out annual full sample surveys on inbound and outbound direct investment stocks based on the provisions of the Foreign Trade and Payments Regulation.[35] Since German companies have to report about their foreign investments to Deutsche Bundesbank there exists a rich database on the balance sheet information of the foreign subsidiaries of German MNC. We use this Micro Database Direct Investment (MiDi) and match it with two other data sources that give us information on the balance sheet information of the parent companies taken from the Deutsche Bundesbank's Ustan and the Hoppenstedt databases.[36] The matching process combines only the parent companies with the corresponding subsidiaries where the identification of the parent company is available. How much of overall German FDI abroad is described by this new sample? Figure 1 shows the share of the firms in our sample in total FDI stocks of German multinational companies in the EU15 countries. On average, they account for around 25 percent of total German FDI in the EU15.

The newly created database gives us a small part of the European tax base for the years 1996 to 2001: It allows us to balance losses and profits of German MNCs and their foreign subsidiaries.[37] The data restrictions allow us to do this only for MNCs based in Germany. But since no other database of comparable quality is available to our knowledge, and given that Germany is economically one of the most important EU countries, the data is a useful starting point for evaluating of possible tax base effects of a switch from SA to FA in the EU. A look at Eurostat FDI data shows that Germany`s share in total FDI stocks within the EU15 is about 14 percent.[38]

[35] See Lipponer (2003a, 2003b) and the appendix for a detailed description of the Micro Database Direct Investment.
[36] See the appendix for a detailed description of the data matching.
[37] Note that balancing profits and losses is not the same as consolidating the firm activities. Our data does not allow calculating a consolidation of profits. Our approach is similar to group taxation with an international loss-offset system.
[38] We used Eurostat data on FDI stocks (Position 505) for the years 1996 to 2001 to calculate this number.

Figure 1: Share of the parent companies in the sample in the total EU15 FDI stocks of German multinational companies for the period 1996-2001



Next to the profits and losses we are also able to calculate the property, sales and the number of employees for each German MNC with subsidiaries in the EU15. Sales are defined as total external sales of a firm in one year including exports. The variable property is defined as the sum of all tangible and intangible assets of the firm. Instead of the payroll data used in current FA systems in Canada and the United States we only have information on the number of employees.[39] We use this number as a proxy for payroll. The profit of a firm is defined as the pre-tax profit of firms before dividends and after tax loss-carry forwards. We use the same positions for both the parent company and the subsidiary. Using the pre-tax profit is reasonable in this setting since we are interested in the tax base of a single firm.[40] The total assets are defined as the balance sheet total of the parent company.

The analysis is based on an unbalanced panel dataset with information about 1844 German parent companies and 5761 foreign subsidiaries.[41] The calculations are

[39] See the appendix for a detailed description.
[40] While the pre-tax profit is directly available for the German parent company we only have after tax profits for the subsidiaries. We used the statutory tax rates to estimate the pre-tax profits of subsidiaries. See the appendix for details.
[41] We exclude the agricultural sector and the public sector companies from the sample.

restricted to subsidiaries in the EU15, i.e. those countries which were EU member states before May 2004.[42]

Table 1 summarises the firm-level data of German firms and subsidiaries in the EU15 for the years 1996 to 2001. Firstly, it should be noted that the firms in the sample are very heterogeneous. The standard deviations are very large for most countries. The first column displays the mean profit of firms for each country (*mprofit*).[43] The mean of firm profits for German parent companies is at least one third higher than the mean profit of the affiliates in the other EU countries. Why is there a profit bias towards Germany? It should be noted that our panel is asymmetric with respect to the distribution of economic activity between Germany and the other countries. In terms of property, sales, and employees, the domestic activity of German parent companies is much larger than economic activity of subsidiaries abroad. This could explain that the profits reported by the parent companies are larger in absolute terms. The mean property in Germany (*mproperty*) is at least three times the size of other countries. The same is true for the mean of sales (*msales*) and the mean number of employees, which are, respectively, four and seven times higher in Germany than abroad.

Not surprisingly, the absolute number of firms in the sample is also highest in Germany since there are many parent companies with only one or two subsidiaries in the EU15. We also find a large number of firms in some smaller countries like the Netherlands and Belgium. These countries are known as preferred locations for headquarters of holding companies.[44] This could be a factor explaining the high number of observations. The geographical neighbourhood to Germany is likely to be another relevant factor for the location of FDI in our sample as the high number of firms in Austria indicates.

[42] We also estimated the tax bases for the EU25 in order to check if our results are robust to variations. The results are available upon request from the authors. The general results do not change when using the EU25. The decrease in the overall tax base is slightly higher. The countries in the EU15 that lose from introducing an FA system do not change when we use the data for the EU25. We do not report the results here since for the time period available the ten countries were not part of the EU which makes a comparison difficult.

[43] Note that loss carry forwards have been considered in these calculations.

[44] The issue of the structure of holding companies in Europe is discussed by Weichenrieder (2005).

Table 1. The mean of profit, property, sales (in thousand Euro), and pre-tax return on total assets per firm for the years 1996-2001

	mprofit	mproperty	Msales	memployees	Number of firms
Austria	818	8.880	46.688	173	702
	(22.114)	(45.412)	(156.264)	(497)	
Belgium	3.372	11.417	71.602	156	427
	(28.086	(66.109)	(355.387)	(778)	
Denmark	245	4.344	29.076	100	208
	(6.649)	(16.095)	(69.128)	(237)	
Finland	1.345	8.107	22.581	68	195
	(5.964)	(38.744)	(56.847)	(177)	
France	1.050	10.427	90.259	230	993
	(49.848)	(52.142)	(653.058)	(868)	
Germany	8.560	66.202	378.836	1686	1.844
	(156.078)	(596.773)	(2.164.687)	(9483)	
Great	-10.210	17.295	80.785	245	790
Britain	(223.247)	(135.137)	(510.215)	(1575)	
Greece	-9	4.423	27.604	108	99
	(2.503)	(7.831)	(47.498)	(174)	
Ireland	2.503	5.560	17.103	90	110
	(14.733)	(18.540)	(39.054)	(194)	
Italy	1.999	9.551	56.082	137	609
	(14.349)	(43.574)	(243.091)	(392)	
Luxemburg	-4.973	11.115	26.068	83	95
	(158.101)	(40.902)	(58.859)	(154)	
Netherlands	6.954	9.834	35.800	109	611
	(162.486)	(53.486)	(102.136)	(238)	
Portugal	1.267	17.314	49.121	225	186
	(10.817)	(84.595)	(189.388)	(526)	
Spain	2.415	11.174	55.832	207	545
	(17.554)	(56.575)	(255.940)	(745)	
Sweden	3.717	20.056	68.260	225	256
	(41.394)	(158.259)	(379.808)	(1498)	

Standard deviations in parenthesis.

*The negative values for these countries are due to large losses of single firms during the sample period.

The descriptive statistics in table 1 clearly show that our sample is not representative for multinational firms in the EU as a whole. This has to be kept in mind when interpreting the results in the following sections.

3 Benchmark case: Separate accounting with national loss offset

The first step in our analysis is to consider the size and the distribution of the tax base under separate accounting (SA). This will serve as a point of reference when analysing an EU tax base with an FA system. We estimate the tax base by calculating

the taxable profit for each firm in each country in the EU and assume that all countries use SA when taxing the corporate income of these firms. This also implies that there is no international loss-offset system in place. The taxable profits are then aggregated for each country. This yields what we call the national tax bases.

The benchmark case with SA can be illustrated using the following example. A German company owns two firms A and B in France. While firm A earns a profit of 100 Euro, firm B has a loss of 50 Euro. Since the two firms in France are in one group, we assume that they are able to consolidate their profits and losses inside France. The tax base in France is therefore 100 - 50 = 50 Euro. All profits of German owned firms in France are summed up after this national loss-offset regime.[45] This gives us the tax base in France for the case of SA.

We calculate the tax base for each EU15 country in every year from 1996 to 2001 in this way. This tax base contains only the corporate income of German FDI in the respective country using an SA approach. We refer to these tax bases as the distribution of tax bases across member countries under the current system of SA. Table 2 shows the sum of the tax base for each country for the years 1996 to 2001.[46]

Generally, large countries tend to have larger tax bases in our sample than small countries. But there are important exceptions. The Netherlands, Austria, Belgium and Sweden have large tax bases, too. This is a sample effect since the number of observations varies among countries and years. Therefore the absolute tax base is larger in countries with many observations. The highest number of observations is available for Germany. Also, as noted in Section 2 the size of the headquarters compared to foreign subsidiaries is large and ties profits to Germany. This is the reason why the German tax base is by far the largest in the sample. Note that the information revealed by this distribution of absolute values of tax bases is limited because it reflects the specific properties of our data sample, i.e. the different numbers of observations. The values in table 2 serve as the starting point to compare the tax base distribution under SA with the pattern emerging under FA.

[45] There are different national loss-offset regimes in the EU member states. Assuming perfect loss-offset across firms of one group within member countries therefore is a simplification.
[46] The yearly tax bases are given in the appendix.

Table 2. The sum of the SA tax base for the EU15 countries in m. Euro for the years 1996-2001

	SA Tax Base
Austria	6.144
Belgium	7.659
Denmark	972
Finland	676
France	16.056
Germany	114.700
Great Britain	8.549
Greece	379
Ireland	1.314
Italy	6.634
Luxemburg	1.363
Netherlands	21.460
Portugal	1.923
Spain	6.897
Sweden	4.691

4 A European tax base

The idea of an EU tax base is to consolidate all European activities of a MNC according to a common set of accounting and tax rules.[47] Such a system also implies an EU wide loss-offset. We calculate such an EU tax base using the profits and losses of German parent companies and their subsidiaries in Europe. For purposes of illustration, assume that a German company has subsidiaries in Spain and Italy. The Spanish subsidiaries earn a consolidated profit of 100 Euro; the Italian firms make losses of 50 Euro. The profit of the German parent company is 50 Euro. A common European tax base would allow an international loss-offset in this scenario. We then have 50 - 50 + 100 = 100 Euro as the European tax base. The MNC's tax base is then apportioned to the countries where the multinational firm is active according to indicators like the amount of property in a country or the sales and payroll in a country.[48] This calculation is made for every single firm in the sample.

This approach to calculating a common European tax base is of course based on strong simplifications compared to the complex questions that arise when actually introducing the jurisdictional framework for the creation of an EU tax base. Firstly,

[47] For a detailed review of the different tax base proposals see Devereux (2004). For an analysis of the efficiency impacts of the Home State Taxation versus the Common Consolidated Tax Base approach see Mintz and Weiner (2003).
[48] These are the usual apportionment factors as used in Canada and the US.

group consolidation is more than just adding profits and losses for tax purposes.[49] Secondly, the EU member countries must agree on accounting standards used to calculate profits. Thirdly, there must be agreement on the definition and the measurement of the factors in the apportionment formula.[50] In so far, our approach of just adding profits and losses is rather crude. But it nevertheless allows to gain a first impression of the effects to be expected if SA is replaced by FA.

5 The choice of apportionment factors

The introduction of an EU tax base raises the question of how the tax base should be divided between the EU member countries. Debates on formula apportionment usually refer to three countries which use this system to allocate tax bases to subnational jurisdictions. These countries are the USA, Canada and Switzerland.[51] The U.S. and the Canadian Systems differ strongly in the method of profit allocation. In the following, we briefly present the U.S. and the Canadian systems[52] and then present the formula used in our calculations which is a combination of the two systems.

The tax liability T_i of a company in a U.S. state i is given by the following equation

$$T_i = t_i\left[\alpha_i^P \frac{P_i}{P} + \alpha_i^L \frac{L_i}{L} + \alpha_i^S \frac{S_i}{S}\right]\pi_i \qquad (1)$$

The U.S. states have the right to choose the tax rate t_i and the weights α_i^j for each apportionment factor j, where P stands for the total property of the firm in the U.S., L for the total payroll, and S for the total sales. The states may also modify the federal tax base, so that the tax base in state i is π_i. Many states use an evenly weighted three-factor formula where $\alpha_j^i = \frac{1}{3}$. This formula is not binding, though. The

[49] For instance, the tax consequences of intra group sales of assets under full consolidation may be different from the consequences under pure profit and loss-offset.
[50] See e.g. Sorensen (2004).
[51] For a detailed description of the systems in these countries see Daly and Weiner (1993).
[52] For reasons of space, we do not describe the Swiss system which is rather complex because the formula used is different for different industries.

fact that U.S. states are allowed to change the weights α_i^j of each apportionment factor may easily lead to double taxation.[53]

The Canadian system grants less discretion to the provinces. The regional governments use the same tax base Π as the federal government and set the local tax rate. In addition, they may give tax credits or incentives to encourage private investment. The tax liability in this system is given by

$$T_i = t_i \left[\frac{1}{2} \frac{L_i}{L} + \frac{1}{2} \frac{S_i}{S} \right] \Pi , \tag{2}$$

i.e. there are only the two factors payroll and sales entering the formula.

Note that, as pointed out by McLure (1980), a formula apportionment system has similar economic effects as a system imposing a tax on each single factor in the formula. In the case of the Canadian formula, it may be considered strange that a tax which supposedly taxes capital income uses only labor and sales in the formula. The reason for this choice of factors is that they are meant as a distribution device to allocate the tax base according to the economic activity of a company in one country. But it is not clear why factors which are more closely related to capital income like, for instance, property, are not included in the formula.

In our analysis we will use a three-factor formula to apportion the tax base to the EU countries. We will use a weight of $\frac{1}{3}$ on each of the factors, i.e. $\alpha_j^i = \frac{1}{3}$. Since our data contains no payroll information for German subsidiaries we apportion income according to the factors sales, property and employees.[54]

Accordingly, the tax liability of a German MNC in country i is

$$T_i = t_i \frac{1}{3} \left[\frac{P_i}{P} + \frac{S_i}{S} + \frac{E_i}{E} \right] \Pi \tag{3}$$

[53] See Goolsbee and Maydew (2000) for a detailed analysis of the change of apportionment weights in the U.S.

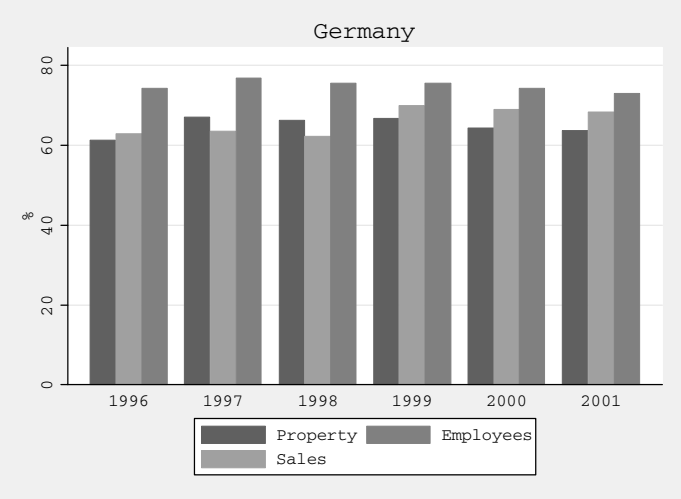
[54] Since the data does provide the number of employees of a subsidiary we can use this value as a proxy for payroll.

where P is the total property of the MNC in the EU15, S the total sales of the MNC, E the number of employees, and Π the taxable profit of the firm. The goal of our analysis is to estimate the tax base of the MNC in each country after Formula Apportionment. We calculate the tax base for every single MNC and sum up the firm-level tax bases to gain information on the national tax bases each country receives.

Figure 2 shows the mean of the apportionment factors for Germany for the years 1996 to 2001 in our sample. Germany has the largest shares of the factors compared to all other European countries. The reason is again that domestic activity of German firms is much larger than economic activity of their European affiliates. The factors range between 61 and 78 percent for Germany.

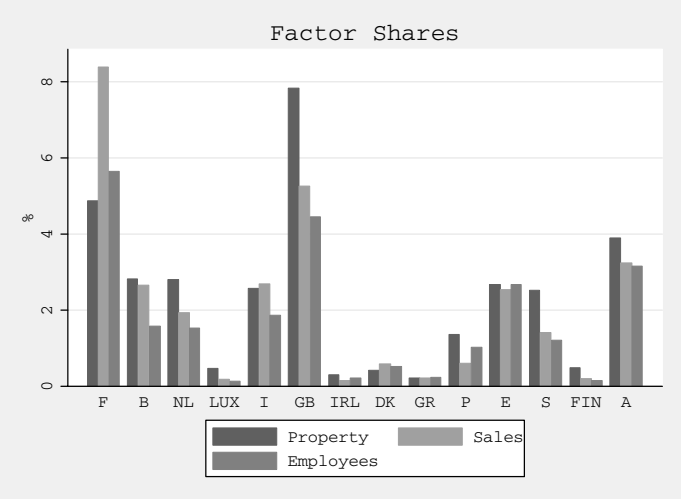
The comparison of apportionment factors for the year 1999 in the other countries (see Figure 3) shows that big countries like France and Great Britain have much higher shares in property and sales than the remaining countries.[55] Moreover, some smaller countries which are geographically close to Germany (Austria, Belgium, and Netherlands) attain almost the same factor shares as countries like Italy and Spain.

Figure 2. Germany's share in European property, sales and employees of German multinational companies



[55] The graphs with the shares for all years can be found in the appendix.

Figure 3. Country shares in European property, sales and employees of German multinational companies in 1999



6 Comparison of tax bases

After defining the consolidated tax base and the apportionment factors we calculate the share of the tax base allocated to each country under FA. As noted in Section 3 the important information generated by this estimation is the difference in tax bases between FA and SA, rather than their absolute size. In the following analysis we will distinguish between two effects of introducing a common EU tax base with FA. Firstly, a redistribution of tax base arises because a given overall tax base is now allocated according to indicators of economic activity instead of profits as measured by separate accounting. The second effect is due to the introduction of border crossing loss-offset. Most importantly, border crossing loss offset reduces the size of the EU-wide tax base. But it also changes the distribution of the tax base across countries. For instance, countries where firms are very profitable and suffer few losses will may lose a significant part of their tax base if domestic profits are set against foreign losses whereas countries where firms suffer high losses anyway will be affected less. As a first step, the next section focuses on the effect of introducing FA without EU-wide loss-offset.

6.1 Formula apportionment without border crossing loss-offset

This section considers the introduction of formula apportionment without border crossing loss-offset.[56] The SA European tax base is calculated by adding up the SA tax bases in the EU15 countries for each firm. If a firm suffers losses in a country, these losses can be carried forward in the country but cannot be set against profits from other countries. Thus, effectively, only profits are added. For each firm, EU wide profits are then distributed across countries according to the apportionment formula discussed above. Consider again the simple example introduced in section 4 of a German parent company with subsidiaries in Italy and Spain. German profits are 50, profits in Spain are 100 and the Italian subsidiary makes losses of 50. We would now sum up profits and ignore losses of the Italian subsidiaries, so that EU wide taxable profits are 150. This tax base is allocated to Italy, Spain and Germany according to the apportionment formula.

The results of this experiment are shown in table 3. The table also replicates the results of the SA case for comparison. It turns out that there are strong shifts in the national tax bases after apportionment. Six countries lose in this scenario: Belgium, the Netherlands, Ireland, Luxemburg, Finland, and Sweden.[57] On the other hand, some countries in Southern Europe like Portugal and Greece win tax base, as does Austria, which gains significantly.[58]

Among the large countries, all receive a larger tax base (Great Britain, Germany, and Spain) or obtain at least more or less the same tax base as in the SA case (France, Italy).

Thus, a pattern emerges where smaller countries and especially countries known for offering attractive tax regimes to MNC tend to lose tax base when firm profits are allocated according to the apportionment factors discussed above. These results could be interpreted as a hint that a significant amount of income shifting is going on under the current SA tax system. Note that the Netherlands, Belgium and Ireland lose a

[56] An introduction of formula apportionment without loss-offset would also be possible, though the discussion in Europe is mainly about FA with loss-offset. Hellerstein (2005) shows that the two elements can exist independently.

[57] The change in national tax bases change varies over the years. This shows that our data is volatile with respect to the national tax bases. The complete graphs of the national tax base shares for the different scenarios can be found in the appendix.

particularly large part of their tax base. These countries had tax regimes during the sample period that offered significant tax incentives to MNCs. While Ireland had a split corporate tax rate with a 10 percent rate on foreign manufacturing companies and special tax regimes like the "Dublin Docks", the Netherlands had attractive tax rules for holding companies and Belgium offered tax incentives for so called co-ordination centres of MNC.[59] These regimes can be used by companies to shift book profits in order to reduce their tax burden. It is plausible that the countries attracting these book profits under the SA system lose when indicators of economic activity are used for the allocation of the tax base.[60] Of course, low corporate tax rates as e.g. in Ireland will not only attract book profits but also real economic activity. But this effect should be reflected in increasing property, employment and sales of subsidiaries in Ireland. It cannot explain a loss in tax base caused by a switch from SA to FA.

[58] The high values for Austria are mainly due to observations in 2001. For the other years the change is still positive but much smaller. The results for Portugal and Greece are based on relatively few observations.

[59] The Belgium co-ordination, distribution and service centres, the Luxembourg co-ordination centres, Ireland split tax rate and the incentives for holding companies in the Netherlands are also mentioned and explained in the EU Code of Conduct on business taxation (1998). Sweden which also loses significantly is mentioned there with a special tax regime for insurance companies.

[60] It should be noted that it is difficult to find empirical evidence for transfer pricing activities since firms obviously try to hide such activities since tax administrations would otherwise enforce taxation and fine companies. Nevertheless, recent research as surveyed by Desai, Foley and Hines (2003) supports the view that companies use profit shifting measures like transfer pricing and thin capitalization in order to avoid taxation in high tax jurisdictions. Our results might therefore be interpreted as another hint for profit shifting.

Table 3. Comparison between the sum of the SA and an FA tax base without international loss-offset for the EU15 countries in m. Euro for the years 1996-2001

	SA Tax Base	Formula Apportionment without Loss-offset	Difference	Change in percent
Austria	6.144	16.793	10.649	173%
Belgium	7.659	5.625	-2.034	-27%
Denmark	972	1.047	75.309	8%
Finland	676	635	-41	-6%
France	16.056	16.129	73	0%
Germany	114.700	121.400	6.714	6%
Great Britain	8.549	13.168	4.619	54%
Greece	379	527	148	39%
Ireland	1.314	793	-521	-40%
Italy	6.634	6.748	114	2%
Luxembourg	1.363	1.114	-249	-18%
Netherlands	21.460	7.543	-13.916	-65%
Portugal	1.923	2.666	744	39%
Spain	6.897	7.273	377	5%
Sweden	4.691	3.053	-1.639	-35%

6.2 Formula Apportionment and international loss-offset

If we add the possibility of border crossing loss-offset, the overall tax base declines. Table 4 shows the values for the 15 countries and for the total EU tax base.

The first result is that now most countries lose part of their tax base compared to the benchmark case with SA. The reason is that many foreign subsidiaries of German firms in EU member states suffered losses in the period between 1996 and 2001 which are now set against profits of other subsidiaries or the parent company.[61] This acts as a tax relief for the MNC, given that tax rates remain unchanged. As a result, all countries lose tax base except for Austria, Greece, and Portugal. When considering the countries where the introduction of an FA system reduces the tax base very strongly we again find that these are the countries with special tax regimes identified above: Netherlands (-74%), Sweden (-57%), Ireland (-51%), and Belgium (-41%). Under SA, these countries receive a share in the overall tax base which is high, relative to real economic activity as measured by the apportionment factors property, sales and employees. When a loss-

[61] See Fuest, Hemmelgarn and Ramb (2005) for an analysis of losses and profits of German FDI in Europe. Ramb and Weichenrieder (2004) also find that German subsidiaries had significant losses in this period.

offset system is introduced these countries lose even more than the results in section 6.1 suggested since the total allocable tax base is now smaller.

Table 4. Comparison of the sum of the SA tax base and the FA tax base for the years 1996-2001 in m. Euro

	SA Tax Base	FA Tax Base	Difference	Change in percent
Austria	6.144	13.005	6.861	112%
Belgium	7.659	4.550	-3.109	-41%
Denmark	972	737	-235	-24%
Finland	676	509	-167	-25%
France	16.056	11.011	-5.045	-31%
Germany	114.700	95.351	-19.313	-17%
Great Britain	8.549	7.869	-680	-8%
Greece	379	435	56	15%
Ireland	1.314	650	-664	-51%
Italy	6.634	4.882	-1.752	-26%
Luxemburg	1.363	829	-534	-39%
Netherlands	21.460	5.481	-15.979	-74%
Portugal	1.923	2.165	242	13%
Spain	6.897	5.777	-1.120	-16%
Sweden	4.691	2.004	-2.685	-57%
EU15	**199.400.000**	**155.300.000**	**-44.100.000**	**-22%**

Under an FA system, Germany still receives a large part of the tax base in the sample, but the European losses of the foreign subsidiaries reduce the German tax base considerably. Perhaps surprisingly, the decline in tax base for Germany (17%) is smaller than the decline in the EU-wide tax base, which is 22%. This pattern should not be overemphasized, though, because we only have information on German MNCs. It is likely that this biases the findings in particular for the German tax base. Table 5 shows the loss in the overall tax base due to border crossing loss-offset for each year in the sample. The decrease in the EU wide tax base fluctuates considerably. It is plausible that additional loss-offset possibilities have a particularly strong impact in boom years like 2000, where many firms make profits and EU wide losses and loss carryforwards can be used extensively.

Table 5. Comparison of the sums of the EU wide SA tax base and the EU wide FA tax base for the years 1996-2001 in b. Euro

	EU wide SA Tax Base	EU wide FA Tax Base	Difference	Change in percent
1996	16,12	13,02	-3,09	-19%
1997	23,35	18,28	-5,08	-22%
1998	24,43	19,75	-4,68	-19%
1999	35,07	28,16	-6,91	-20%
2000	52,60	34,90	-17,70	-34%
2001	47,81	41,14	-6,67	-14%
Sum	**199,4**	**155,3**	**-44,1**	**-22%**

7 Conclusion

What effects would the introduction of a common tax base with formula apportionment have? The calculations in this paper lead to two main results. Firstly, if an FA system without loss-offset is introduced, small countries and in particular low tax countries or countries with special tax incentives for MNCs, which are commonly thought to attract book profits under the current system, would lose tax base. This happens because, under the current SA system, these countries attract a share of the EU wide tax base which is higher than their share in real economic activity as measured by indicators like property, sales or payroll. On the other hand, larger countries tend to increase the share in the common tax base in an FA system without loss-offset. This reflects that, under the current system, the share of larger countries in the common tax base is small, relative to their share in economic activity. Since corporate taxes in these countries are high compared to the EU average, these results are consistent with the view that profit shifting takes place under the current tax system.

The second key result is that if a border crossing loss-offset is added to the FA system there is a significant effect on the overall size of the common European corporate tax base. The introduction of an EU tax base with loss-offset would imply that the overall tax base and most national tax bases decrease. According to our calculations, the overall tax base declines by approximately 20 percent. If we assume that countries do not alter their tax rates this change is the same for the tax revenue.

Both findings – the redistribution of tax base across countries and the decline in the overall tax base – suggest that the introduction of a common EU tax base with formula apportioning faces formidable political and economic challenges.

All these results, though, should be evaluated in the light of the limitations of the data used in this study. Our analysis is based on the data of German outward FDI in the EU15 and the respective German parent companies only. It is unclear to which extent our findings can be generalized. Furthermore, we do not consider behavioural changes that might take place when introducing FA. Nevertheless, our calculations give a first idea of how countries' tax bases and, hence, tax revenues could be affected if an EU corporate tax base with FA became a reality. The advantage of using German data is that German companies have many subsidiaries all over Europe which makes the dataset an imperfect but nevertheless useful tool for the approximation of overall tax base effects. Another more technical insight of our analysis is that there is a need for a European database that allows forecasting the revenue effects of such fundamental tax changes in greater detail.

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9 Appendix: Data description

FDI data

The Deutsche Bundesbank carries out annual full sample surveys on inbound and outbound direct investment stocks based on the provisions of the German Foreign Trade and Payments Regulation. Due to this legal regulation, foreign companies with investments in Germany have to report balance sheet information of their German subsidiaries. The balance sheet data are calculated using the German accounting regulations. Similarly, German multinational companies have to report the same information about their foreign affiliates. The data is available for the years 1989 to 2003.

Time series for individual companies are available for the years 1996 to 2003. In 2002, about 6.000 domestic investors filed reports on around 22.000 foreign subsidiaries abroad. With respect to inward FDI, in 2002 data are available for about 10.000 affiliates in Germany, in which some 7.000 foreign investors had a participating interest. For a detailed description of the FDI database (MiDi), see Lipponer (2003a) and Lipponer (2003b).

In order to calculate an international loss-offset regime, we only use data from 1996 on. The panel dataset contains 1.844 German parent companies and 5.761 foreign subsidiaries in the EU15. This is of course a rather small amount of firms which also creates problems. This makes the data sensitive to small changes in the estimation setting. Nevertheless, the result that a decline in the EU tax base of around 20 percent occurs and that smaller countries tend to lose when FA is introduced are robust to different settings. For example we reduced the number of apportionment factors to sales and property where results did not change significantly.

The subsidiaries are based in the following EU15 countries: France (F), Belgium (B), Netherlands (NL), Luxembourg (LUX), Italy (I), Great Britain (GB), Ireland (IRL), Denmark (DK), Spain (E), Sweden (S), Finland (FIN), and Austria (A). 75 Percent of all subsidiaries are wholly owned by the German parent company and 90 percent are owned with a share higher than 51 percent. The mean of the parent's share in the

foreign subsidiary is 91 percent. We therefore assume for simplicity that the subsidiaries are all fully owned, since we have no information on other non-German shareholders.

The most important branches of activity of the parent companies in our data set are Manufacturing, Holdings, Wholesale and Services to Companies. We concentrate on incorporated non-public companies that have either the legal form of a corporation or a limited liability company. Note that the fact that we observe holdings as an important form of German parent companies probably leads to an underestimation of the factor shares in Germany. The reason is that we cannot observe German subsidiaries of the German parent companies which would of course be part of the group. We therefore underestimate the tax base Germany receives in an FA system slightly.

German firm data

We use two datasets which we combine with the MiDi. The Ustan (Deutsche Bundesbank's Corporate Balance Sheet Statistics) is available from 1989 to 2001 while the Hoppenstedt database is available from 1996 to 2004. While Ustan contains tax and commercial balance sheet data, Hoppenstedt only covers commercial balance sheets of German corporations. Unfortunately, the data collection of Deutsche Bundesbank for the Ustan ends in 2001 which leads to a sharp drop in the number of German parent companies for the years 2002 to 2003. We therefore report only the results for the years 1996 to 2001. A detailed description of Ustan is provided by Stoess (2001). We have information on the tax balance sheets for 50 percent of the parent companies.

Matching the data

In order to combine our dataset we use a matching procedure that adds to every foreign subsidiary a German parent company if an identification variable is available. If the parent is found in Ustan and Hoppenstedt we choose the Ustan data since it contains also tax balance sheets which are more appropriate for our research which aims at estimating tax bases on the firm level.

The information on the number of employees is not mandatory for the subsidiaries. We therefore have to deal with missing data for this variable. We solve this problem by using two steps. Firstly, if a firm reports employees in some years but not in all we replace the missing by the mean of the number of employees for this year. Secondly, if we have no observations at all we run a simple regression where

employment is the dependent variable and sales and property the explaining variables. This regression is used to estimate the employment data for firms without any information on employment. We do this in order to maximize the number of observations which would other wise be reduced significantly. In order to check for robustness we also used a two factor formula where only sales and property are used as apportionment factors. This did not change the results of our analysis.

One important difference in the German data and the FDI data is the definitions of profit. While the data on German parent companies provides the pre-tax profits we only have information on the after tax profits of the foreign subsidiaries. We try to deal with this problem by using the statutory corporate tax rate of the host country and use it as multiplier in order to estimate roughly the pre-tax profit of companies. The calculation is simply

$$p^{pre-tax} = \frac{p}{(1-t)} \qquad \text{(A1)}$$
$$p = p^{pre-tax}(1-t)$$

where t is the statutory tax rate and p is profit.

Yearly data for all countries

On the two pages we added the yearly shares of the countries in the apportionment factors and the share in the tax base each country receives. The first figure shows the factors. The second figure shows the tax base shares each country receives. We aggregated the national SA and FA tax bases and calculated the share each country receives. The first column is the share in the SA tax base, the second the share in the FA tax base without loss-offset while the last column shows the share in the tax base for the FA case with formula apportionment.


Country Shares in Property, Sales and Employees
Austria
Belgium
Denmark
Finland
France
Germany
Great Britain
Greece
Ireland
Italy
Luxembourg
Netherlands
Portugal
Spain
Sweden
1996 1997 1998 1999 2000 2001
Property
Employees
Sales

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

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.

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.

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

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.[62] 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 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

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

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.[63] 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.[64] 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.[65] In line with expectations, TI is defined as the sum of TI_{t-1} and a random innovation ε_t at time t.[66]

Fehler! Es ist nicht möglich, durch die Bearbeitung von Feldfunktionen Objekte zu erstellen. (9)

[63] 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.
[64] The Devereux (1989) study is an exception.
[65] 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.
[66] For a precise description of the technique using an example, see Graham and Lemmon (1998) and Shelvin (1990).

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[67] ($t+1$ 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.[68] 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.

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,

[67] Empirical models typically use a forecast for a 20-year period.
[68] 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.

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 three 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.[69] 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.[70] 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.[71] A panel data set for the 1971-2002 period is currently available for research purposes.[72]

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

[69] A complete account of the statistics including the methodology can be found in Deutsche Bundesbank (1998) and Stöss (2001).
[70] For details of the methodology, see Deutsche Bundesbank (2004).
[71] 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).

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.

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

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).[73] 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.

[73] 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.[74]

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

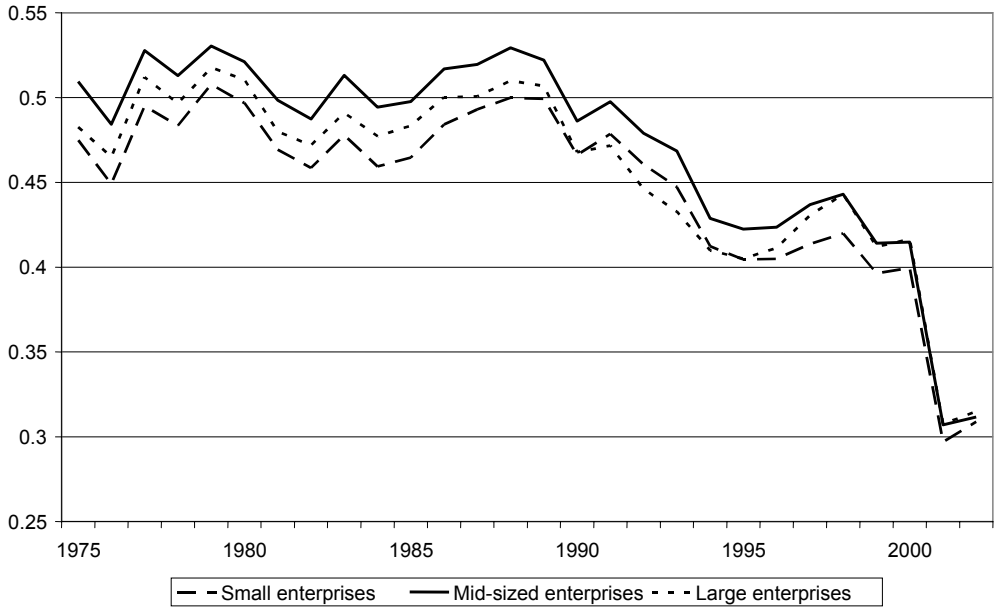
Table 7. Revenue relevance of loss carryforwards (values in millions)

	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.[75] 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.[76]

[75] The program was programmed in Stata; a copy may be obtained from the author on request.
[76] 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.[77] 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.

[77] 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[78] and GMM.[79] The results can be found in table 8, the number of lag lengths used having been determined iteratively.[80] 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.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.[81] 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.[82] 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

[78] All fixed effects estimations were calculated using the first-difference estimation approach. Asymptomatically, this leads to the same results as the "within" estimation approach.
[79] 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.
[80] The optimal lag lengths are determined by excluding insignificant lags.
[81] Known as the Nickell bias.
[82] For a discussion of this effect see Kiviet and Philips (1993).

data series.[83] 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.

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

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.

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.[84] 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

[84] 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.

Besides the ADL model, the empirical literature often uses the more structural Error-Correction-Model (equation 10).[85] 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.

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 $(\gamma_0 + \gamma_1 + \gamma_2) = 0.010$.[86] 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.

[85] Empirical results for Germany may be found in Harhoff and Ramb (2001).
[86] This is the coefficient for log marg tax rate (t-2) in table 10.

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 marg 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	

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 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 in front 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.[87] 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 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

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

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 isrelevant, 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 rate based 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 result 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 profitaability. In a model which combines the Graham marginal tax rates and EATR or 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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