Taxes and limited liability – An economic analysis

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Dipl.-Kffr. Britta Mantei
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Referenten

Professor Dr. Kay Blaufus
Professor Dr. Stefan Wielenberg

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Summary

The dissertation studies the impact of taxation on the assumption of liability under uncertainty. The decision on the provision of liability is often exercised by the choice of organizational form since liability limitations are one of the most important factors for the choice of legal form (e.g., Buschmann (2005), Zieren (1989)). The taxation's influence on the choice of legal form is analysed intensively in the national and international research literature (e.g., Hundsdoerfer et al. (2008)). There are a high number of contributions addressing different questions regarding the taxation's impact, e.g., differences in tax rates, time effects and cross-border issues (e.g., Herzig/Sander (1999), Freyer (2004), König et al. (2013)). Also questions regarding the neutrality of tax systems concerning organizational forms are discussed (e.g., Siegel, (2004), Wagner (2006)). Most of the articles assume certain payments so that the influence of tax effects due to liability limitations is not analysed. The contributions which consider uncertainty often neglect the influence of liability limitations on the cash flows. Furthermore, taxation is mostly integrated in a simplified way (e.g., Gordon/MacKie-Mason (1994), Horvath/Woywode (2005), Becker/Fuest (2007), Ewert/Niemann (2012)). The dissertation aims to follow up on this issue and analyses different aspects of taxation with the specific focus on tax effects caused by uncertainty on the assumption of liability and thus the choice of legal form.

This dissertation consists of three different essays according to section 2 Promotionsordnung (doctoral regulation) of the School of Economics and Management, Leibniz University Hannover. The following table provides an overview of the articles' title, co-authors and status of publication. The essays are summarized in the following.

Title	Co-authors	Status of publication
Taxes, risky investments, and the simultaneous choice of organizational form and financing	Kay Blaufus	Journal of Business Economics (2014), 84: 1111 - 1141
Interest deductibility restrictions and organizational form	Kay Blaufus, Marcos Kreinacke	Business Research (2014), DOI 10.1007/s40685-014-0016-6
Collateral and taxation	—	Working paper

Table 1: Overview of essays

Taxes, risky investments, and the simultaneous choice of organizational form and financing

The choice of organizational form is a widespread issue in the research of business theory. Empirical studies show that taxes as well as liability limitations are two of the most important decision factors for the choice of organizational form. There are a high number of contributions analyzing the effect of taxation on the choice of organizational form. Thereby, the uncertainty of payouts is mostly ignored and thus, the relevance of liability limitations as decision criterion is not analysed.

In this article, we concentrate on this specific issue. We analyse the effect of a differentiated tax system on the simultaneous choice of organizational form and financing under uncertainty in a one-period model with two future states. At the same time different risk attitudes as well as the consequences of liability limitations on the after tax cash flow are taken into consideration.

In order to concentrate the analysis on the tax effects that additionally arise due to liability limitations, we will assume that there are no tax rate differences that depend upon the organizational form. Thus, in a risk-free world, investors are indifferent between the compared legal forms (corporations and partnerships) and taxes do not have any influence on the choice of organizational form.

The results show, that even in the case of identical tax rates of corporations and partnerships, taxes can influence the choice of organizational form under uncertainty if we consider risky investments. The reasons for this are differences in the tax base of corporations and partnerships due to different liability limitations. On the one hand, rational creditors require a risk premium for granting risky debt capital to compensate their default risk. This affects the amount of interest payments and thus, the tax bases of firms with limited and unlimited liability differ. On the other hand, the separation principle has to be taken into account for firms with limited liability. Hence, losses on the firm level cannot immediately be offset against positive income on the shareholder level. Regarding firms with unlimited liability that are taxed according to the transparency principle, losses can generally be offset against shareholders' profits. Even in the case of identical tax rates, these differences in the tax base can lead to an impact of taxes on the choice of organizational form.

Choosing a firm with limited liability can be interpreted as a form of "insuring" the risk of the loss of equity. Risk-averse investors choose a totally debt financed firm with limited liability if they face fairly calculated risk premiums. A different tax treatment of debt financing and equity financing can encourage or hamper the acquisition of this "insurance". Accordingly, there is interdependence between the optimal organizational form and its optimal financing in the case of risk. Hence, general statements about the impact of taxation on the choice of organizational form cannot be made without knowledge of the taxation of the financing. For organizational form neutrality, the identity of the tax

rates of corporations and partnerships is not sufficient under risk. Additionally, the tax rate on interest has to equal the firms' tax rate.

However, we demonstrate that even if the tax rate on interest and the firms' tax rate differ, in a high number of cases the decision on the choice of organizational form does not change due to the consideration of taxation. This is because in most countries debt financing is tax-preferred in comparison to equity financing and thus, the acquisition of the "insurance" is encouraged. Furthermore, the tax disadvantage due to the restricted loss offset of firms with limited liability can be avoided by choosing the optimal form of financing. Thus, the actual impact of taxation on the choice of organizational form is relevant only in the rarest cases.

Interest deductibility restrictions and organizational form

The taxation of dividends and interest payments differ in most countries. Typically, interest payments are tax-deductible in contrast to dividend payments so that debt financing is privileged for tax purposes. To constrain the tax benefit of the use of debt, the deductibility of interest payments is often limited by interest deductibility restrictions (IDR). In many countries IDR are applied in the same way to corporations and partnerships. There are a high number of contributions on the impact of interest deductibility restrictions on a firm's capital structure and investment policy. Despite the legislator's declared aim to design tax systems that do not distort the choice of organizational form, the impact of IDR on the choice of legal forms is almost completely neglected in the literature and previous research has studied the impact of IDR almost exclusively on corporations.

In this paper, we analyse the impact of IDR on the choice of organizational form and consider the two most widely used IDR. The first sort of IDR links the interest deductibility to a specific leverage ratio. Interest payments for debt that exceeds a specific leverage ratio are not tax-deductible. The second sort of IDR, the so-called earnings-stripping rules, restricts the tax-deductible interest payments to a specific percentage of the firm's earnings and thus to a profit-dependent amount.

To focus the analysis exclusively on the effects caused by an IDR we use a baseline model with a tax system that is neutral in the sense, that investors are indifferent between a corporation and a partnership. We use a one-period model under uncertainty and derive the effects analytically. Furthermore we use a Monte Carlo simulation to study the effects of varying leverage ratios, risk-free interest rates and investment risk on tax differences between corporations and partnerships due to IDR.

The results show that IDR generally distort the choice of organizational form.

The incorporation of leverage-based IDR as well as EBITDA-based IDR in a neutral tax system leads to opposing effects. The existence of dividend taxation causes a tax advantage for corporations because the IDR only affects the tax base on the corporation level but not on the shareholders' level. Conversely, the asymmetric tax treatment of interest payments and default gains leads to a tax disadvantage for corporations. If default gains, arising from the inability of a corporation to meet the liabilities, are taxed to a higher extent than interest payments are tax-deductible, corporations face a disadvantage in comparison to partnerships.

We demonstrate that only a specific form of leverage-based IDR can be neutral to the choice of organizational form. This requires a symmetric tax treatment of interest payments and default gains as well as a full loss offset and either legal form-dependent tax parameters or the absence of dividend taxation. This is in contrast to actual tax law. If loss offset restrictions are apparent, the IDR always distort the choice of organizational form. Therefore, the legislator's aim to achieve organizational form neutrality is in conflict with the existing tax systems.

Collateral and taxation

The assumption of liability is an important factor when it comes to the choice of legal form. By choosing a corporation, one's liability can be limited to the company's assets. The extension of liability is often required in case of bank lending, so that the provision of a shareholders' guarantee as collateral can be useful for various reasons.

The use of collateral is widespread in practice and there are a high number of theoretical and empirical contributions addressing different questions of collateral also in the context of asymmetric information, e.g., investment policy, capital structure policy, and incentive problems. The taxation of collateral as a factor which could influence the provision of collateral has not yet been examined.

In this paper, I address this research gap by analysing the effects of a differentiated tax system in a one-period, two-state model under uncertainty. A worthwhile risky real investment opportunity is given and risk-neutral investors, as shareholders of a corporation, decide on the provision of a guarantee. The investors' decision on the provision of collateral is analysed in a world with and without taxation under perfect information. The comparison of the results show that taxation can either encourage or hamper the provision of collateral. Thus, the well-known result that the existence of collateral is redundant under perfect information has to be clarified in consideration of taxation.

On the one hand, in the profit state, the provision of collateral reduces the creditors' default risk and decreases the required risk premium as well as the tax deductible amount of interest. This leads to a tax disadvantage for the

investors. On the other hand, in the state of loss, collateral reduces the (taxable) default gain and therefore the tax base on the corporation level. This leads to a tax benefit that is distributed to the creditors and reduces, again, the risk premium. On the shareholder level, the invoked guarantee results in subsequent acquisition costs which could lead to an additional tax benefit in case of bankruptcy. Additionally, the consideration of transaction costs can influence the decision on the provided collateral but not the direction of the tax effects. Thus, dependent on the actual tax law, especially different tax rates as well as tax-relevant valuation principles determine the overall tax effect.

The decision on the assumption of liability in terms of provided collateral can be interpreted as kind of legal form choice. Further research could integrate information asymmetry as well as further aspects of taxation (e.g., loss offset restrictions), sorts of risk attitudes or different designs of (un-) limited liability to analyse the correlation of a legislative framework and the assumption of liability.

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Zusammenfassung

Die Dissertation untersucht den Einfluss der Besteuerung auf die Haftungsübernahme unter Unsicherheit. Die Entscheidung über die Haftungsübernahme wird oft durch die Rechtsformentscheidung vorgenommen, denn Haftungsbeschränkungen sind einer der wichtigsten Faktoren für die Rechtsformentscheidung (z.B. Buschmann (2005), Zieren (1989)). Der Einfluss der Besteuerung auf die Rechtformentscheidung wird in der nationalen und internationalen Forschungsliteratur intensiv untersucht (z.B. Hundsdoerfer et al. (2008)). Es gibt eine Vielzahl an Beiträgen, die unterschiedliche Fragestellungen in Bezug auf den Einfluss der Besteuerung analysieren, z.B. Unterschiede in den Steuersätzen, Zeiteffekte und grenzüberschreitende Sachverhalte (z.B. Herzig/Sander (1999), Freyer (2004), König et al. (2013)). Ebenso werden Fragestellungen zur Neutralität von Steuersystemen in Bezug auf unterschiedliche Rechtsformen diskutiert (z.B. Siegel (2004), Wagner (2006)). Die meisten Beiträge nehmen sichere Zahlungströme an, so dass der Einfluss von Besteuerungseffekten, die aufgrund von Haftungsbeschränkungen auftreten, nicht untersucht werden. Die Artikel, die Unsicherheit berücksichtigen, vernachlässigen häufig den Einfluss der Haftungsbeschränkung auf die Zahlungsströme. Weiterhin wird die Besteuerung meist in stark vereinfachter Form einbezogen (z.B. Gordon/MacKie-Mason (1994), Horvath/Woywode (2005), Becker/Fuest (2007), Ewert/Niemann (2012)). Die Dissertation soll hieran anknüpfen und untersucht verschiedene Aspekte der Besteuerung mit speziellem Fokus auf Besteuerungseffekte, die durch die Unsicherheit der Haftungsübernahme und damit durch die Rechtsformentscheidung auftreten.

Die Dissertation besteht aus drei eigenständigen Beiträgen gemäß § 2 der Promotionsordnung der Wirtschaftswissenschaftlichen Fakultät der Leibniz Universität Hannover. Die nachstehende Tabelle gibt einen Überblick über die Titel der Beiträge, die Koautoren sowie den Publikationsstand. Die Beiträge werden im Folgenden kurz zusammengefasst.

Titel	Koautoren	Publikationsstatus
Taxes, risky investments, and the simultaneous choice of organizational form and financing	Kay Blaufus	Journal of Business Economics (2014), 84: 1111 - 1141
Interest deductibility restrictions and organizational form	Kay Blaufus, Marcos Kreinacke	Business Research (2014), DOI 10.1007/s40685-014-0016-6
Collateral and taxation	—	Working paper

Tabelle 1: Überblick über die Forschungsbeiträge

Taxes, risky investments, and the simultaneous choice of organizational form and financing

Die Rechtsformentscheidung ist in der betriebswirtschaftlichen Forschung ein weit verbreitetes Thema. Empirische Studien zeigen, dass Steuern ebenso wie Haftungsbeschränkungen zwei der wichtigsten Einflussfaktoren für die Rechtsformentscheidung sind. Es gibt eine Vielzahl an Beiträgen, die den Einfluss der Besteuerung auf die Rechtsformentscheidung untersuchen. Dabei wird die Unsicherheit von Zahlungsströmen häufig vernachlässigt und damit auch die Relevanz der Haftungsbeschränkung als Entscheidungskriterium nicht analysiert.

In diesem Beitrag konzentrieren wir uns auf diesen Aspekt. Wir untersuchen den Einfluss eines differenzierten Steuersystems auf die simultane Entscheidung über die Rechtsform und die Finanzierung unter Unsicherheit in einem Ein-Perioden-Modell mit zwei Zuständen. Gleichzeitig werden unterschiedliche Risikoeinstellungen ebenso wie die Auswirkung von Haftungsbeschränkungen auf den Cashflow nach Steuern berücksichtigt.

Um die Analyse auf die Steuereffekte zu konzentrieren, die zusätzlich durch Haftungsbeschränkungen auftreten, werden wir annehmen, dass es keine rechtsformabhängigen Steuersatzunterschiede gibt. In einer risikolosen Welt sind Investoren daher indifferent zwischen den verglichenen Rechtsformen (Kapitalgesellschaften und Personenunternehmen) und Steuern haben keinen Einfluss auf die Rechtsformentscheidung.

Die Ergebnisse zeigen, dass Steuern sogar im Fall identischer Steuersätze von Kapitalgesellschaften und Personenunternehmen die Rechtsformentscheidung unter Unsicherheit beeinflussen können, wenn wir riskante Investitionen betrachten. Die Gründe hierfür sind Unterschiede in der steuerlichen Bemessungsgrundlage bei Kapitalgesellschaften und Personenunternehmen aufgrund unter-

schiedlicher Haftungsbeschränkungen. Auf der einen Seite fordern rationale Gläubiger eine Risikoprämie für die Vergabe von riskantem Fremdkapital zur Kompensation ihres Ausfallrisikos. Dies wirkt sich auf den Betrag der Zinszahlung aus, so dass sich die steuerlichen Bemessungsgrundlagen von Unternehmen mit beschränkter und unbeschränkter Haftung unterscheiden. Auf der anderen Seite muss das Trennungsprinzip bei Unternehmen mit beschränkter Haftung beachtet werden. Somit können Verluste auf Unternehmensebene nicht sofort mit positiven Einkünften auf Anteilseignerebene verrechnet werden. Unternehmen mit unbeschränkter Haftung, die nach dem Transparenzprinzip besteuert werden, können Verluste im Allgemeinen mit Gewinnen der Anteilseigner verrechnen. Sogar im Fall von identischen Steuersätzen können diese Unterschiede in den steuerlichen Bemessungsgrundlagen zu einem Einfluss der Besteuerung auf die Rechtsformentscheidung führen.

Die Wahl einer Rechtsform mit beschränkter Haftung kann als eine Form der "Versicherung" für das Risiko des Eigenkapitalverlustes interpretiert werden. Risikoaverse Investoren wählen ein vollständig fremdfinanziertes Unternehmen mit beschränkter Haftung, wenn sie sich fair kalkulierten Risikoprämien gegenübersehen. Eine unterschiedliche steuerliche Behandlung von Fremdfinanzierung und Eigenfinanzierung kann die Übernahme der "Versicherung" fördern oder behindern. Dementsprechend besteht unter Risiko eine Interdependenz zwischen der optimalen Rechtsform und deren optimaler Finanzierung. Daher können allgemeine Aussagen über den Einfluss der Besteuerung auf die Rechtsformentscheidung ohne Kenntnis der Besteuerung der Finanzierung nicht getroffen werden. Für Rechtsformneutralität ist die Identität der Steuersätze von Kapitalgesellschaften und Personenunternehmen unter Unsicherheit nicht ausreichend. Zusätzlich muss der Steuersatz auf Zinsen dem Unternehmenssteuersatz gleichen.

Dennoch zeigen wir, dass, sogar wenn der Steuersatz auf Zinsen und der Unternehmenssteuersatz sich unterscheiden, in ei ner großen Anzahl von Fällen die Entscheidung über die Rechtformwahl sich nicht durch die Berücksichtigung von Steuern ändert. Dies liegt daran, dass in den meisten Ländern die Fremdkapitalfinanzierung steuerlich bevorzugt wird im Vergleich zur Eigenkapitalfinanzierung und damit der Erwerb der "Versicherung" gefördert wird. Weiterhin kann der Steuernachteil aufgrund der Beschränkung der steuerlichen Verlustverrechnung durch die Wahl der optimalen Finanzierung vermieden werden. Somit ist die tatsächliche Wirkung der Besteuerung auf die Rechtsformentscheidung nur in den seltensten Fällen relevant.

Interest deductibility restrictions and organizational form

Die Besteuerung von Dividenden und Zinszahlungen unterscheidet sich in den meisten Ländern. Typischerweise sind Zinszahlungen im Gegensatz zu Divi-

dendenzahlungen steuerlich abzugsfähig, so dass Fremdfinanzierung für steuerliche Zwecke bevorzugt wird. Um den Steuervorteil der Fremdkapitalnutzung zu begrenzen wird die Abzugsfähigkeit von Zinszahlungen oft durch Zinsabzugsbeschränkungen (IDR) begrenzt. In vielen Ländern gelten IDR in gleicher Weise für Kapitalgesellschaften und Personenunternehmen. Es gibt eine Vielzahl von Beiträgen zu dem Einfluss von Zinsabzugsbeschränkungen auf die Kapitalstruktur von Unternehmen und die Investitionspolitik. Trotz des vom Gesetzgebers erklärten Ziels, Steuersysteme zu konzipieren, die nicht die Rechtsformentscheidung verzerren, wird der Einfluss von Zinsabzugsbeschränkungen auf die Rechtsformentscheidung beinahe vollständig in der Literatur vernachlässigt und die vorangegangene Forschung hat den Einfluss von IDR ausschließlich auf Kapitalgesellschaften untersucht.

In diesem Beitrag analysieren wir den Einfluss von IDR auf die Rechtsformentscheidung und berücksichtigen die zwei am weitesten verbreiteten IDR. Die erste Art von IDR knüpft die Zinsabzugsfähigkeit an einen bestimmten Verschuldungsgrad. Zinszahlungen für Fremdkapital, das einen spezifischen Verschuldungsgrad übersteigt, sind nicht abzugsfähig. Die zweite Art von IDR, die sogenannten "earnings-stripping rules" beschränkt die steuerlich abzugsfähigen Zinszahlungen auf einen spezifischen Prozentsatz der Unternehmensgewinne und damit auf einen gewinnabhängigen Betrag.

Um die Untersuchung auf die Effekte zu fokussieren, die durch eine IDR verursacht werden, verwenden wir ein Basismodell mit einem neutralen Steuersystem in dem Sinne, dass Investoren indifferent zwischen einer Kapitalgesellschaft und einer Personenunternehmung sind. Wir verwenden ein Ein-Perioden-Modell unter Unsicherheit und leiten die Effekte analytisch ab. Außerdem nutzen wir eine Monte Carlo Simulation, um die Wirkungen von unterschiedlichen Verschuldungsgraden, risikolosen Zinssätzen und Investitionsrisiken auf die aufgrund der IDR entstehenden Steuerunterschiede zwischen Kapitalgesellschaften und Personenunternehmen zu untersuchen.

Die Ergebnisse zeigen, dass IDR im Allgemeinen die Rechtsformwahl verzerren. Die Einbeziehung einer verschuldungsgradabhängigen IDR ebenso wie einer EBITDA-basierten IDR in ein neutrales Steuersystem führt zu gegensätzlichen Effekten. Die Existenz einer Dividendenbesteuerung verursacht einen Steuervorteil für Kapitalgesellschaften, weil die IDR sich nur auf die steuerliche Bemessungsgrundlage auf Unternehmensebene auswirkt und nicht auf Anteilseignerebene. Im Gegenzug führt die asymmetrische steuerliche Behandlung von Zinszahlungen und Verbindlichkeitswegfall zu einem Steuernachteil für Kapitalgesellschaften. Wenn ein Verbindlichkeitswegfall, entstanden durch das Unvermögen der Kapitalgesellschaft die Verbindlichkeiten zu begleichen, in höherem Ausmaß besteuert wird als Zinszahlungen abzugsfähig sind, dann sehen sich Kapitalgesellschaften einem Nachteil gegenüber im Vergleich zu Personenunternehmen.

Wir zeigen, dass nur eine spezifische Form der verschuldungsgradabhängigen IDR neutral sein kann in Bezug auf die Rechtsformwahl. Dies erfordert eine sym-

metrische Besteuerung von Zinszahlungen und Verbindlichkeitswegfall ebenso wie eine vollständige Verlustverrechnung und entweder rechtsformabhängige Besteuerungsparameter oder die Nichtexistenz von Dividendenbesteuerung. Dies steht im Gegensatz zum aktuellen Steuerrecht. Wenn Verlustverrechnungsbeschränkungen existieren, verzerrt die IDR stets die Rechtsformwahl. Daher steht das Ziel des Gesetzgebers, Rechtformneutralität zu erreichen, im Gegensatz zu dem bestehenden Steuersystem.

Collateral and taxation

Die Haftungsübernahme ist ein wichtiger Faktor, wenn es zu einer Rechtsformentscheidung kommt. Durch die Wahl einer Kapitalgesellschaft kann die Haftung auf das Unternehmensvermögen begrenzt werden. Im Fall der Kreditvergabe wird von Banken oft die Ausweitung der Haftung gefordert, so dass die Stellung einer Gesellschafterbürgschaft als Sicherheit aus verschiedenen Gründen sinnvoll sein kann.

Der Gebrauch von Sicherheiten ist in der Praxis weit verbreitet und es gibt eine Vielzahl von theoretischen und empirischen Beiträgen, die unterschiedliche Fragestellungen in Bezug auf Sicherheiten auch im Kontext asymmetrischer Information untersuchen, z.B. Investitionspolitik, Kapitalstrukturpolitik und Anreizprobleme. Die Besteuerung von Sicherheiten als ein Faktor, der die Stellung von Sicherheiten beeinflussen könnte, wurde bisher nicht untersucht.

In diesem Beitrag gehe ich diese Forschungslücke an und untersuche die Wirkung eines differenzierten Steuersystems in einem Ein-Perioden-Modell mit zwei Zuständen unter Unsicherheit. Gegeben ist eine lohnenswerte riskante Realinvestition und risikoneutrale Investoren entscheiden als Gesellschafter einer Kapitalgesellschaft über die Stellung einer Bürgschaft. Die Entscheidung der Investoren über die Stellung von Sicherheiten wird in einer Welt mit und ohne Berücksichtigung von Steuern unter perfekter Information untersucht. Der Vergleich der Ergebnisse zeigt, dass die Besteuerung die Stellung von Sicherheiten sowohl fördern als auch behindern kann. Daher muss das bekannte Ergebnis, dass die Existenz von Sicherheiten bei perfekter Information redundant ist, unter Berücksichtigung von Steuern präzisiert werden.

Auf der einen Seite vermindert die Stellung von Sicherheiten das Ausfallrisiko der Gläubiger und verringert die geforderte Risikoprämie ebenso wie den steuerlich abzugsfähigen Zinsbetrag im Gewinnzustand. Dies führt zu einem Steuernachteil für die Investoren. Auf der anderen Seite vermindern Sicherheiten den (steuerpflichtigen) Verbindlichkeitswegfall im Verlustzustand und damit die steuerliche Bemessungsgrundlage auf Unternehmensebene. Dies führt zu einem Steuervorteil, der an die Gläubiger ausgezahlt wird und damit nochmals die Risikoprämie verringert. Auf Anteilseignerebene führt die in Anspruch genommene Bürgschaft zu nachträglichen Anschaffungskosten, die im Insolven-

zfall zu einem zusätzlichen Steuervorteil führen könnte. Außerdem kann die Berücksichtigung von Transaktionskosten zwar die Entscheidung über die Stellung von Sicherheiten beeinflussen, jedoch nicht die Richtung der Steuereffekte. Abhängig vom aktuellen Steuerrecht können daher vor allem unterschiedliche Steuersätze ebenso wie steuerlich relevante Bewertungsprinzipien den steuerlichen Gesamteffekt bestimmen.

Die Entscheidung über die Haftungsübernahme in Form von der Stellung von Sicherheiten kann als eine Art Rechtsformentscheidung interpretiert werden. Weitere Forschung könnte Informationsasymmetrie sowie weitere Aspekte der Besteuerung (z.B. Verlustverrechnungsbeschränkungen), verschiedene Risikoeinstellungen oder andersartige Ausführungen von (un-)beschränkter Haftung einbeziehen um den Zusammenhang zwischen den rechtlichen Rahmenbedingungen und der Haftungsübernahme zu analysieren.

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Collateral and taxation

Britta Mantei[a]

[a] *Leibniz Universität Hannover*

Abstract

Empirical studies show that the majority of loans are secured. Collateral, as a form of liability, is widely used to reduce the lenders default risk. A lot of different aspects are analysed empirically and theoretically in the context of the use of collateral. But, the integration of collateral's taxation has not yet been studied. The purpose of this paper is the analysis of tax effects on the provision of guarantees for risky debt capital in a simple one-period model under uncertainty. Therefore, risk-neutral investors decide about the optimality of the securitization of granted loans in a world with and without taxation. The results show that taxation can but not necessarily does change the investors' decision. Thus, the well-known result that the existence of collateral is redundant under perfect information has to be clarified in consideration of taxation: tax benefits can justify the existence of collateral under perfect information.

Keywords Limited liability . Taxation . Collateral

JEL classification G3 . H25 . K34 . M21

1 Introduction

When it comes to the choice of a company's legal form, the assumption of liability is very important and can be determined by choosing a legal structure (e.g., Buschmann (2005), Zieren (1989)). In principle, one's liability can be limited to the company's assets by choosing a corporation. The choice of an unlimited liable company, e.g. a partnership, implies that the shareholders' private wealth is also liable for the firm's obligations. Although changing legal forms to another is possible, the decision for one legal form is quite restrictive

because the change is accompagnied with various transaction costs. Another possibility to vary the assumption of liability is the provision of securities. For various reasons it can be rational to extend the liability by providing collateral, for example in form of a guarantee, if a project is meant to be carried out in a corporation.

The topic of collateral is often discussed in the literature. Moral hazard and asymmetric information problems are seen as the two major reasons for the use of collateral. As shown in several models, the use of collateral is redundant under perfect information. Thus, only the consideration of information asymmetry often justifies the existence of collateral. There are a lot of theoretical and empirical studies in the context of secured lending which mainly integrate asymmetric information.

Information asymmetry between a lender and a borrower is often associated with the risk of the borrower's project, e.g., Bester (1985, 1987), Chan/Kanatas (1985), Besanko/Thakor (1987a, b). It is generally measured by differing default probabilities of the projects. Borrowers who are defined as "good borrowers" typically face a lower default probability than "bad borrowers". All these models assume that the provision of collateral is combined with corresponding costs that differ between good and bad borrowers (as the default probability of the good borrowers is lower). To compensate for the default risk for the lender, collateral and interest rate requirements often act as substitutes in loan contracts.

The provision of securities can be used as a sorting device in the context of imperfect information. Using different loan contracts as the self-selection mechanism, Bester (1985) showed that an equilibrium can be characterized by the separation of borrowers with different risk.[1] As a result, good borrowers typically provide more collateral than bad borrowers because good borrowers gain from being identified as less risky. However, these findings are opposed by several empirical studies, e.g., Berger/Udell (1990), Jiménez/Saurina (2004).

Another strand of the literature considers the possibility of increasing the success probability by increasing effort, e.g., Chan/Thakor (1987), Boot et al. (1991), Pozzolo (2002). In this context, moral hazard problems are taken into consideration and collateral is used as incentive device to afford more effort. The more expensive the loss of collateral is, the more worthwhile it is to increase effort. In his model, Pozzolo (2002) shows that under perfect information collateral and interest rate requirements can function as complements and not as substitutes. Thus, risky borrowers pledge more collateral because the creditors compensate higher risk with securitization and higher interest rates. In their study, Boot et al. (1991) present in this context that the additional consideration of asymmetric information leads to an increase of provided collateral by good borrowers. They also found that when the interest rate is increased, the level of collateral

[1] Credit rationing does not occur because it is possible to screen different types of borrowers, Bester (1985), p. 850. In their seminal paper, Stiglitz/Weiss (1981) show that credit rationing can occur. Their findings basically result from adverse selection effects and the problem that an increasing interest rate could promote risikier projects.

increases as well.

In his study, Koziol (2007) focused precisely on the question whether "good borrowers" pledge more collateral than "bad borrowers". He considers proportional bankruptcy costs and costs for pledging collateral explicitly. Thus, the optimal choice of collateral results from the tradeoff between reduced interest payments, lower bankruptcy costs and the costs arising from pledging collateral. It is shown that the allocation of information is crucial for the optimal choice of collateral. Under perfect information, "good borrowers" pledge less collateral than "bad borrowers", while under asymmetric information the relation is reversed.

There are several other essays addressing different questions regarding the topic of collateral. Some examples include the correlation with the maturity of the loans or strength of the lending relationship (e.g., Lensink/Pham (2006), Ortiz-Molina/Penas (2008), Steijvers et al. (2010)), exogenous variation of lender information (e.g., Berger et al. (2011)), credit market competition (e.g., Jiménez et al. (2006)) or stochastic future values of collateral and stochastic success probabilities (Niinimäki (2011)). For a survey of theoretical and empirical research on the use of collateral, see Coco (2000) and Steijvers/Voordeckers (2009).

Although there are a high number of contributions on the issue of taxation and liability focusing the optimal choice of legal form, all of the above mentioned articles did not integrate taxation at all.

Addressing the question of the justification of double taxation for corporations, Becker/Fuest (2007) modeled an investment decision of investors with limited and unlimited liability. They do not model collateral, but vary the assumption of liability through the supply of limited liability contracts and unlimited liability contracts for bank loans. Assuming a highly simplified tax system, they derive the investors' investment decision under perfect information and under asymmetric information concerning the investors' type and the risk of the project. The investors' type is determined by their risk attitude modeled by a(n) (un-)restricted taxable loss offset. Their model shows that asymmetric information can lead to overinvestment in a world without taxation. An additional tax on limited liability contracts reduced the incentive to overinvest and leads to an efficient equilibrium. Thus, corporate taxation is seen as means of correcting the failure of the capital market. Miglo (2007) extends the model of Becker/Fuest (2007) by adding a modified production technology and shows that both overinvestment and underinvestment can arise. As in Becker/Fuest's (2007) article, he does not model collateral explicitly and neglect differentiated tax effects.

In this paper I address this research gap by analysing the effects of a differentiated tax system under perfect information on the provision of collateral as means to assume liability. To consider this issue, I extend a model previously used by Blaufus/Hundsdoerfer (2008), Blaufus/Mantei (2014) and Blaufus et al. (2014) by integrating the possibility to assume collateral and its differentiated

taxation. Therefore, risk-neutral investors decide on their optimal amount of provided collateral in a one-period model under uncertainty. The results show that taxes can either encourage or hamper the provision of collateral. Thus, even under perfect information, tax benefits can justifiy the existence of collateral. The optimal provision of collateral as device for the assumption of liability can be interpreted as kind of legal form choice and is analysed from the investors' point of view.

The remainder of this paper is organized as follows: In the following section, the baseline model is presented with a short derivation of the investors' decision in a world with perfect information and without taxation. In section (3), taxation is taken into consideration, first in a general manner, subsequently with particular regard to German tax law. The paper concludes with the summary of the results and a brief discussion in section (4).

2 Baseline Model - without Taxation

In the baseline model, the risk-neutral investors are situated in a one-period model under uncertainty and aim to maximize their expected future value FV. In $t = 0$ they have an initial endowment of $W \geq 0$ and face a worthwhile risky real investment opportunity that can be conducted in a corporation that is also found in $t = 0$.

The investment expenditure amounting to I_0 can be financed with debt (λI_0) and with equity ($(1 - \lambda) I_0 \leq W$). The endowment that is not used for the real investment ($W - (1 - \lambda) I_0$) is invested risk-free on the capital market. The debt ratio is defined as $0 \leq \lambda \leq 1$. Debt capital is offered by risk-neutral creditors. The capital market is competitive and free of arbitrage. There is no restriction to investing and lending risk-free capital. The risk-free interest rate is denoted by r_f.

In $t = 1$ there are two possible future states, s "high" and "low", with $s = h, l$. State $s = h$ ($s = l$) occurs with the investor specific success probability p_i ($1 - p_i$) and promises a return of the real investment amounting to CF_h (CF_l).[2] The success probability p_i can be seen as a measurement for the investors' business risk. The success probability can be different e.g. due to different effort, different personal characteristics etc. The investors have to pay back the loan λI_0 as well as the required interest payment on the debt capital $i\lambda I_0$. There is no information asymmetry.

To investigate the relevance of liability limitations the default risk of the creditors is modeled as follows. The return of the real investment in state high (CF_h) covers the entire liabilities of the investor, in state low the return of the invest-

[2] The investigation is limited to two future states without loss of generality. It is sufficient to model the uncertainty with one state "high" and one state "low" where the liability limitation becomes relevant. For further analysis of multiples state, see Blaufus et al. (2014).

ment, CF_l, does not cover the debt liabilites, the corporation goes bankrupt. Due to the limited liability of the corporation the bank has no access to the private wealth of the shareholders. Thus, the creditors face a default risk with a probability $1 - p_i$.[3] Anticipating the default risk, the creditors will charge a risk premium (RP) for lending risky capital.

The amount of the debt ratio of the real investment also determines the investment of the remaining capital on the capital market ($W - (1 - \lambda) I_0$). In this analysis, the amount of the debt ratio (and thus the alternative investment of the remaining initial endowment) does not influence the results of the research question for several reasons. First, under the assumption of an unrestricted capital market with the opportunity of risk-neutral lending and investing, the financing decision is irrelevant in a world without taxation for risk-neutral investors.[4] Second, in a world with taxation, even under uncertainty the financing decision is only driven by differences between the tax rate on interest income and on corporate income.[5] These tax rates are assumed to be identical in this model so that the general implications of the analysis are not distorted by differing debt ratios. Thus, the consideration of the capital market investment of the remaining endowment is not necessary for the analysis of the influence of taxation on the collateralization and neglected in the formulas.[6]

The investors have the opportunity to lower the corporation's liability limitations and provide collateral $C \geq 0$ to the creditors. In t = 0 they decide on the amount of the collateralization (C), with the optimal amount being denoted by C^*. The collateral can be interpreted as a guarantee given by the corporation's shareholders. Assuming that there is unrestricted access to collateral (the shareholders own sufficient private wealth), the granted debt (respectively the receivables of the creditors) can be secured completely and compensates the creditors' investment risk. In this case, the situation equals an unlimited liable company.[7] The value of the collateral is assumed to be constant over time.

From the investors' point of view, the additional costs of providing collateral are not modeled here. In general, the additional costs of collateral only hamper the provision of collateral and make it more attractive to limit the liability and take an unsecured loan. Moreover, insolvency costs, reputation costs or similar are neglected.[8] From the creditors' point of view, transaction costs, for example arising from the liquidation of the collateral, are taken into account in form

[3] The default probability of every investor is given exogenously. For endogenous default probability, see Blaufus et al. (2014).

[4] Increasing debt leads to an increase of the capital market investment. The interest received with the interest rate r_f equal the expected interest payments to the creditors. Thus, the financing decision does not influence the expected utility of the future value of risk neutral investors (see Blaufus/Mantei (2014), p. 1118).

[5] See Blaufus/Mantei (2014), p. 1121.

[6] Several essays do not integrate an initial endowment or the possibility of equity financing. See e.g., Boot et al. (1991) and Koziol (2007), who excludes equity financing and concentrates his analysis on the maximization of the value of the debt financed project.

[7] For the derivation of the maximal effective collateral, see Appendix (5.1).

[8] See e.g., Besanko/Thakor (1987a).

of a valuation haircut of the collateral. This assumed disparity in collateral valuation between the investors and the creditors influences the required risk premium and thus occurring tax effects. The provided collateral is valued by the creditors with a proportional factor $0 \leq \alpha \leq 1$ as αC. Hence, the value of collateral that is recovered in the state of loss is lower for the creditors than for the investors if $\alpha < 1$.[9] The payments to the creditors in $t = 1$ are denoted by $D_s = D_h, D_l$. In state low, it is necessary to distinguish between creditors and investors; the additional subscript cv indicates the "creditors' valuation". In state high there is no difference. It holds $D_h = D_{h-cv} \forall \alpha$ and $D_l \geq D_{l-cv} \forall \alpha \leq 1$.

$$D_{s-cv} = \begin{cases} D_{h-cv} & = \lambda I_0 (1+i) \quad with\, p_i \\ D_{l-cv} & = CF_l + \alpha C \quad with\, 1-p_i \end{cases} \tag{1}$$

In state high the creditors receivables are fully paid. They receive the redemption of the granted loan λI_0 as well as the required interest payment $i\lambda I_0$. In state low, the return of the investment CF_l (equals the wealth of the corporation in $t = 1$) as well as the collateral C is payed to the creditors. The remaining outstanding liability cannot be met. To compensate the default that occurs with probability $1 - p_i$, risk-neutral creditors demand a nominal interest rate $i \geq r_f$ to get an expected return equal to the risk free capital market interest rate r_f. The risk premium is denoted by $RP = i - r_f \geq 0$.

The creditors calculus results in:

$$\lambda (1 + r_f) \quad = \quad E [D_{s-cv}] \tag{2}$$

and leads to the following risk premium:[10]

$$RP = \frac{1 - p_i}{p_i} \cdot \frac{\lambda (1 + r_f) - CF_l - \alpha C}{\lambda} \tag{3}$$

The investors decide about collateralization of the borrowings in order to maximize the expected utility of the future value of the risky investment:

$$E [U (FV_s)] = E [U (CF_s - D_s)] \tag{4}$$

with $FV_h = CF_h - \lambda I_0 (1 + i)$ and $FV_l = CF_l - D_l = -C$.[11] Without loss of generality, the investment expenditure is scaled to $I_0 = 1$ in the following.

[9] For the use of valuation disparities, see e.g., Barro (1976), Besanko/Thakor (1987a), Boot et al. (1991), Pozzolo (2002), Koziol (2007). The amount of α is common knowledge and equal for every creditor.

[10] For the derivation of the risk premium, see Appendix (5.2).

[11] The investor specific utility functions are denoted by U_i ($U_i' > 0; U_i'' = 0$). See Appendix (5.3) for the derivation of the future values.

The investors' calculus of maximizing the expected utility of the future value with respect to the amount of collateral leads to the following result:[12]

$$\frac{\partial E\left[U\left(FV\right)\right]}{\partial C} = \left(1 - p_i\right)\left(\alpha U_h^{'} - U_l^{'}\right) \tag{5}$$

Within this model framework, the following proposition holds:

Proposition 1. *In a world without taxation and with perfect information, risk-neutral investors are indifferent about the assumption of liability for* $\alpha = 1$. *Risk-neutral investors do not provide any collateral for* $\alpha < 1$.

Proof. The marginal utility of risk-neutral individuals is constant $U_h^{'} = U_l^{'}$. Thus, the optimal condition is equal to zero for $\alpha = 1$ and negative for $\alpha < 1$. □

Risk-neutral investors are indifferent concerning the risk allocation. The parameter α specifies the potential valuation haircut due to transaction costs on the creditors' side. For $\alpha = 1$, a change in the provided collateral has no influence on the expected utility of the future value. Creditors and investors evaluate the provided liability in the same way, thus, the collateral is valued "symmetrically". The advantage of lower interest payments due to the provision of collateral exactly compensates the disadvantage of loosing the collateral in expectation. For $\alpha < 1$, an increase in the provided collateral decreases the expected utility of the future value. It is not worth providing collateral for the debt if the collateral is valued "asymmetrically". The investors are better off in restricting the liability and taking the loan unsecured. Thus, the consideration of transaction costs as disparity in valuation of the collateral from the creditors' point of view leads to the disappearance of the assumption of liability in this model context. Hence, risk-neutral investors would provide collateral if and only if the provided liability is valued symmetrically. Nevertheless, the existence of collateral is redundant under perfect information without taxation. These well-known results are also presented e.g. by Besanko/Thakor (1987a), p. 676, Chan/Thakor (1987) p. 350. Table 1 summarizes the investors' decision:

Table 1: Investors' optimal assumption of liability without taxation

Perfect information	
$\alpha = 1$	$C^* = indifferent$
$\alpha < 1$	$C^* = 0$

[12] For the derivation of the result, see Appendix 5.3.

3 Integration of taxation

From this point on, taxation is integrated in the model above. It is analysed in the following section if the assumed design of the tax system can distort the choice of liability. After presenting the general assumptions of the tax system, the investors' decision under perfect information is presented and different tax cases concerning the taxation of collateral (here in form of a shareholders' guarantee) are outlined. It is shown that the decision about the collateralization depends on several parameters and solely nominal tax rates can have an influence on the decision of liability.

3.1 General assumptions

Taxation should be considered on the level of all participating parties, including the firm level and the shareholder level of the corporation as well as the level of the creditors. The creditors' calculus determines the required risk premium and is independent of the creditors' taxation if a proportional tax rate is assumed. Hence, the creditors' taxation has no influence on the price of liability and the decision about the collateralization. This aspect can be neglected in this analysis and is not presented here.[13] The following remarks specifiy the assumptions for the taxation of the corporation on the firm level and on the level of the investors as shareholders of the company.

All tax tarifs are assumed to be proportional. On the firm level, the corporation's income is taxed with a proportional corporate income tax rate τ_{cit}. The shareholder level taxation is denoted by the proportional tax rate τ_s. The entire tax burden of the corporation is defined by the combined tax rate $\tau_c = \tau_{cit} + \tau_s (1 - \tau_{cit})$. A full and immediate loss offset is assumed as well as the full deductibility of interest expenses and the full taxability of default gains.[14] The investment expenditure amounting to $I_0 = 1$ is capitalized in t = 0 and depreciated in t = 1 entirely.

Corporation - firm level

The tax base on the firm level consists of the return of the risky investment less the full depreciation of the investment expenditure less the deductible interest expenses in state high and plus the taxable default gain in state low.

The default gain arises in state low and is defined as the non-paid part of the debt capital, and is thus calculated as the debt capital less the cashflow,

[13] On the creditors level, the tax base consists of the interest payment in state high and the bad-debt loss in state low. In expectation the creditors receive the risk-free interest rate that is taxed. For further information, see Blaufus/Mantei (2014), p. 1120.

[14] For the analysis of loss offset restrictions, see, e.g., Blaufus/Mantei (2014), p. 1123; for effects due to interest deductibility restrictions, see Blaufus et al. (2014).

the tax payment and the invoked guarantee. For tax reasons, the amount of guarantee can be treated differently. To consider different kinds of tax effects the parameter, $0 \leq \beta \leq 1$ is introduced. It specifies the taxability of the amount of the drawn guarantee for the default gain. For $\beta = 1$, the default gain is reduced by the full amount of the invoked guarantee, for $\beta = 0$, the invoked guarantee does not influence the outstanding liabilities and thus does not affect the taxable gain.[15] The default gain results in:

$$DG = \lambda - (CF_l - T_{cit-l} + \beta C) \tag{6}$$

The tax payments on the firm level of the corporation result in state high:

$$\begin{aligned} T_{cit-h} &= \tau_{cit} (CF_h - 1 - \lambda i) \\ &= \tau_{cit} (CF_h - 1 - (D_h - \lambda)) \end{aligned} \tag{7}$$

and in state low:

$$\begin{aligned} T_{cit-l} &= \tau_{cit} (CF_l - 1 + DG) \\ &= \tau_{cit} (CF_l - 1 - (D_l - \lambda) + C (1 - \beta)) \end{aligned} \tag{8}$$

Corporation - shareholder level

The tax base of the shareholders consists of the distribution of the corporation less the acquisition costs of the participation. Due to the liquidation of the corporation in t = 1, the income of the shareholders from the real investment equals the distribution of the corporation's remaining liquidity. The distribution is equal to the cashflow less the payments by the company to the creditors less the tax payment on the firm level. The acquisition costs arise as a result of the initially invested equity $I_0 (1 - \lambda)$ and, generally, the amount of the liquidated collateral C. To consider different situations concerning the taxation of the guarantee on the shareholder level, the parameter $0 \leq \gamma \leq 1$ is introduced. It defines the part of the guarantee that is taken into account as subsequent acquisition costs.[16]

The tax payments on the shareholder level result in state high:

$$\begin{aligned} T_{s-h} &= \tau_s (CF_h - D_h - T_{cit-h} - (1 - \lambda)) \\ &= \tau_s (CF_h - 1 - (D_h - \lambda) - T_{cit-h}) \end{aligned} \tag{9}$$

and in state low:

[15] For a detailed description of different tax treatments and the analysis in conformity with the German tax law, see section 3.2 and 3.3 below.

[16] For the more detailed analysis of the consideration of a drawn guarantee as subsequent acquistion costs also in conformity with the German tax law, see section 3.2 and 3.3 below.

$$\begin{aligned} T_{s-l} &= \tau_s \left(CF_l - D_l - T_{cit-l} - (1-\lambda) + C\,(1-\gamma)\right) \\ &= \tau_s \left(CF_l - 1 - (D_l - \lambda) - T_{cit-l} + C\,(1-\gamma)\right) \end{aligned} \tag{10}$$

Corporation - total

The entire tax payment of the corporation follows from (7) and (9) in state high:

$$T_{c-h} = \tau \left(CF_h - 1 - (D_h - \lambda)\right) \tag{11}$$

Using $D_l = CF_l - T_{cit-l} + C$ leads to (12) and shows the impact of the amount of collateral on the tax burden in state low:[17]

$$T_{c-l} = \tau \left(CF_l - 1 - (D_l - \lambda)\right) + \tau_{cit}\,(1-\tau_s)\,C\,(1-\beta) + \tau_s C\,(1-\gamma) \tag{12}$$

Adjustment of the risk premium

The risk premium is not influenced by the creditors taxation, but by the tax payment on the firm level. As in the world without taxation, in state high the cashflow is high enough to cover the corporation's tax payment and the creditors' receivables. In state low the cashflow does not cover the outstanding liabilities. Assuming full and immediate loss offset, the corporation receives a tax refund $T_{cit-l} < 0$ due to the tax loss of the real investment. The tax refund increases the corporation's liquidity and thus the payment to the creditors in state low:

$$D^{\tau}_{s-cv} = \begin{cases} D_{h-cv} & = \lambda I_0\,(1+i) \qquad\quad with\; p_i \\ D_{l-cv} & = CF_l + \alpha C - T_{cit-l}\; with\; 1-p_i \end{cases} \tag{13}$$

The creditors' default risk and the risk premium is lower than without taxation:[18]

$$RP^{\tau} = \frac{1-p_i}{p_i} \cdot \frac{\lambda\,(1+r_f) - CF_l - \alpha C + T_{cit-l}}{\lambda} \tag{14}$$

The investors' expected utility of the future value results in:

$$E\left[U\left(FV^{\tau}_s\right)\right] = E\left[U\left(CF_s - D_s - T_{c-s}\right)\right] \tag{15}$$

[17] For the derivation of the tax payments, see Appendix (5.4).

[18] The valuation of the collateral, parameter α, is independent of the taxation.

with $FV_h^\tau = CF_h\,(1-\tau) + \tau - \lambda\,(1 + r_f\,(1-\tau)) - \lambda RP^\tau\,(1-\tau)$ and $FV_l^\tau = -C - T_{s-l}$.[19] To analyse the tax effects concerning the assumption of liability, the investors' decision is first derived in a general way and subsequently with particular consideration of the German tax law.

3.2 Analysis of tax effects

The investors' optimal condition for the assumption of liability has changed due to taxation, the decision is not independent of the tax-parameters. The derivative of the expected utility of the future value with respect to the amount of collateral leads to the following result:[20]

$$\begin{aligned} \frac{\partial E[U(FV^\tau)]}{\partial C} \quad = \quad & (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ & + U_h^{'}\,(1-p_i)\,[-\tau\alpha + \beta\tau_{cit}\,(1-\tau_s)] \\ & + U_l^{'}\,(1-p_i)\,\tau_s\gamma \end{aligned} \tag{16}$$

In comparison to equation (5), the additional terms in row two and three clarify the tax effects. In state high, the tax burden is affected indirectly by the amount of collateral. The influence of the amount of collateral on the risk premium results in a change in deductible interest payments. The collateral decreases the risk premium and thus lowers the tax deductible amount with the factor α. As the tax rate increases, the incentive to provide collateral is reduced. Furthermore, the collateral lowers the taxable default gain with the factor β and leads to a decrease of the tax refund that results in an increases of the risk premium and its tax deductibility in state high. This indirect tax effect of the default gain encourages the provision of collateral. In state low the shareholders' subsequent acquisition costs increase by the amount of the collateral with factor γ, lower the shareholders' tax base and promote the assumption of liability. The sign of equation (16) and thus the overall effect of the integration of taxation is not obvious.

Within this model framework, the following proposition holds:

Proposition 2. *In a world with taxation and perfect information, the decision of risk-neutral investors about the assumption of liability depends on the tax rates and the amount of the parameters α, β and γ.*

Proof. With $U_h^{'} = U_l^{'}$ the optimal condition is equal to zero if $\alpha\,(1-\tau) + \beta\tau_{cit}\,(1-\tau_s) + \tau_s\gamma = 1$. Thus, the sign of the optimal condition and thereby the advantageousness of the assumption of liability depends on the tax rates and on the valuation parameter α as well as on the tax parameters β and γ. □

[19] For the derivation of the future values, see Appendix (5.6).
[20] For the derivation, see Appendix (5.6).

Taxation of collateral

There are an infinite number of combinations of the tax rates and the parameters α, β and γ that could lead to a positive or negative impact of provided collateral on the expected utility.

A corporation's collateral is often provided by a shareholder's guarantee. If creditors face bad debt, they draw on the shareholder's guarantee. Their receivables are met and the claims go beyond to the guarantors. Hence, on the level of the corporation, it is not the sum of the liabilities that changes, but the recipient. The corporation is no longer liable toward their creditors, but to their shareholders.[21] In case of financial distress or insolvency (here in state low) the shareholders (as guarantors) typically waive the recourse claims so that the liabilities can be derecognized on the firm level. A hidden contribution emerges if the claims waiver results from the corporate relationship. On the shareholder level, the hidden contribution generally leads to subsequent acquisition costs of the participation. Thus, in state low the reduction of the default gain due to the claims waiver is denoted by βC, the increase of the acquisition costs increase with γC.

To analyse the effects of the taxation, the possible values of the parameters β and γ have to be clarified. Thus, one must examine how the payments caused by the guarantee influence the tax base on the firm level and on the shareholder level. The valuation parameter $0 \leq \alpha \leq 1$ is independent of the consideration of taxation. For given tax rates τ_{cit} and τ_s, three conceivable cases of parameter combinations are shortly presented hereinafter for $\alpha = 1$.[22] The following equations show that taxation does not necessarily influence the assumption of liability.

(i) $\beta = \gamma = 1$

In the first case, the tax parameters are both equal to one. The amount of the invoked guarantee equals the amount that is taken into account as subsequent acquisition costs and as reduction of default gain. The optimal condition results in:

$$\begin{aligned} \frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)\,\tau\,(1-\alpha) \\ &= 0 \end{aligned} \tag{17}$$

For $\beta = \gamma = 1$ and $\alpha = 1$, risk-neutral investors are indifferent concerning the assumption of liability. The optimal condition corresponds to equation (5) in a

[21] If the called guarantee only partly covers the outstanding liabilities, the liability only partly changes the recipient. In the context of the model it would not make sense to provide collateral that has a lower value than the outstanding liabilities.

[22] For further information and for $\alpha < 1$, see a short explanation below and Appendix (5.6).

world without taxation. Hence, if there is no valuation haircut of the collateral itself and no tax specific valuation difference, the investors' decision whether or not to provide collateral is not influenced by taxation.

(ii) $\beta = \gamma < 1$

In the second case, the tax parameters are equal but smaller than one. The amount of the invoked guarantee is higher than the amount that is taken into account for tax purposes. The optimal condition results in:

$$\begin{aligned} \frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)\,\tau\,(\beta-\alpha) \\ &= -U^{'}(1-p_i)\,\tau\,(1-\beta) < 0 \end{aligned} \tag{18}$$

For $\beta = \gamma < 1$ and $\alpha = 1$, the optimal condition is negative. The tax effect of the collateral leads to the result that risk-neutral investors prefer to take the unsecured loan. The tax disadvantage resulting from the reduction of the tax-deductible risk premium due to increasing collateral is greater than the tax benefit caused by higher acquisition costs on the shareholder level.

(iii) $\beta \neq \gamma$

In the third case, β and γ differ. The parameters are introduced in the model to allow the adjustment of the tax-relevant value of the guarantee, but they can also represent different tax rates and assume a value greater than one.

$$\frac{\partial E[U(FV^{\tau})]}{\partial C} = U^{'}(1-p_i)\left[-\tau + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma\right] \tag{19}$$

For $\beta \neq \gamma$ and $\alpha = 1$, the sign of the optimal condition is not unambiguous. It depends on the value and the relation of β and γ. A positive sign of (19) requires at least one parameter to have a value greater than one. To restrict the analysis to realistic scenarios, the following three cases are examined according to German tax law.

3.3 Consideration of German tax law

In Germany, the tax-relevant amount of the invoked guarantee is generally determined by the fair value.[23] For tax purposes, a distinction must be made between the recoverable part of the outstanding claim and the worthless claim.

A hidden contribution is made to the extent that the receivable is valuable. On the firm level, the hidden contribution does not trigger additional profit

[23] See sec 6 par. 1 no. 5 German Income Tax Act.

resulting from the claims waiver and reduces the default gain (here, denoted by $C\beta$). The worthless part of the receivable leads to a taxable profit as part of the default gain ($C(1-\beta)$). On the shareholder level, in accordance with the correspondence principle of the German Tax Law,[24] the recoverable part of the claim determines the amount of the subsequent acquisition costs (here, denoted by $C\gamma$). The worthless part counts as taxable private capital loss ($C(1-\gamma)$). This leads to the conclusion that, in general, the impairment of the receivable is crucial for the amount of the parameters β and γ, and thus, the taxable consideration as subsequent acquisition costs and the corresponding reduction of the outstanding liabilities.

(i) $\beta = \gamma = 1$

In the first case, the amount of the invoked guarantee equals the amount that counts as the hidden contribution and subsequent acquisition costs. In accordance with established German case law, this case can occur if the guarantee is assumed due to the corporate relationship.[25] For example, this includes guarantees that are intended for crisis situations or are even granted during hard times. Thus, independent of the fair value of the receivable (and thus the hidden contribution), the entire amount of the invoked guarantee is taken into account, both on the firm level as reduction of the default gain and on the shareholder level as subsequent acquisition costs.[26]

(ii) $\beta = \gamma < 1$

The second case, represents a situation in which the fair value of the receivable is lower than the nominal value and determinant for tax purposes. The reference date for the fair value is the point of time when the guarantee results from the corporate relationship.[27] If the guarantor retains his guarantee agreement in times of crisis, this is caused by the corporate relationship and hence, according to sec 6 par. 1 no. 5 German Income Tax Act, the fair value of the hidden contribution is determinant for the tax-related effects. Due to the intendend principle of correspondence in the German tax law,[28] the parameters β and γ generally have the same value.

[24] See sec. 8 par. 3 Corporation Tax Code.

[25] See Federal Court of Finance judgements, e.g., of 2nd October 1984, 9th September 1986, 24th April 1997, 4th March 2008.

[26] See Federal Court of Finance judgements, e.g., of 26th January 1999, 20th April 2004.

[27] See e.g., Federal Court of Finance judgement of 6th July 1999.

[28] See sec. 8 par. 3 Corporation Tax Code.

(iii') $\beta = 1 < \gamma$

In the third case, the parameters β and γ differ. This can occur for example if different tax rates are relevant.

Under German tax law, natural persons, as shareholders of a corporation, generally have to tax 60 % of their positive income from their participation at their personal income tax rate $\tau_s = 0,6 \cdot \tau_{pit}$. Hence, 40% of the participation income is tax-exempt.[29] Accordingly, a prohibition of partial deduction applies for negative income that is related to the participation.[30] Thus, the same tax rate applies (τ_s) and only 60% of expenses or losses are tax-deductible. The Federal Court of Finance decided that the partial prohibition of deduction for expenses under section 3c German Income Tax Code does not apply if the taxpayer did not receive any revenue through the participation.[31] This also holds true for the issue at hand.[32] Hence, the subsequent acquisition costs are tax-deductible with a higher tax rate $\tau_{pit} > \tau_s$ and therefore $\gamma > 1$. This leads to an encouragement of the provision of collateral. For case (iii'), it holds $\alpha = 1$, $\beta = 1$ and $\gamma > 1$ and the optimal condition results in:

$$\begin{aligned} \frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ &\quad + U_h^{'}(1-p_i)\left(-\tau\alpha + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma\right) \\ &= U_h^{'}(1-p_i)\,\tau_s\,(\gamma - 1) > 0 \end{aligned} \tag{20}$$

The optimal condition is positive.[33] With increasing collateral, the tax disadvantage due to the reduction of the tax-deductible risk premium is smaller than the tax benefit because of the lower tax payment caused by higher acquisition costs. The additional tax advantage on the shareholder level resulting from the tax deductibility with a factor $\gamma > 1$ leads to a positive effect of provided collateral on the expected utility of the future value for risk-neutral investors.

Overall, it can be noticed that the tax parameters can change the collateral's advantageousness. Taxation can either encourage or hamper the assumption of liability. As explained above, for $\alpha < 1$ the provision of collateral becomes more unattractive, but the direction of the tax effects remain unchanged. In case (i), the taxation does not cause an additional effect, the provision of collateral is not optimal for $\alpha < 1$. In case (ii), the negative tax effect amplifies the negative effect of the asymmetric valuation so that collateral is optimally not provided. In case (iii'), the positive tax effect can overcompensate the negative valuation effect but the result is not unambiguous. The results are shortly presented in table 2:

[29] See sec. 3 no. 40 German Income Tax Code.

[30] See sec. 3c German Income Tax Code.

[31] See e.g., Federal Court of Finance, judgements of 14th July 2009; 6th April 2011.

[32] See Finance Court Düsseldorf, judgement of 20th November 2012, Federal Court of Finance, judgment of 20th August 2013.

[33] For other combinations of β and γ with one parameter greater than one and one parameter less than one, the sign of the equation (20) is not unambiguous (see above case (iii)).

Table 2: Investors' optimal assumption of liability with taxation under perfect information

	case (i)	case (ii)	case (iii')
	$\beta = \gamma = 1$	$\beta = \gamma < 1$	$\beta = 1 < \gamma$
$\alpha = 1$	$C^* = indifferent$	$C^* = 0$	$C^* = C^{max}$
$\alpha < 1$	$C^* = 0$	$C^* = 0$	ambiguous

4 Conclusion and discussion

Building on the articles by Blaufus/Mantei (2014) and Blaufus et al. (2014), this paper concerns the question of tax effects on the provision of collateral.

Empirical studies show that the majority of loans are secured and even personal commitments are often required.[34] But, previous research neglects possible effects of a differentiated tax system on the provision of collateral. In this essay, it is shown that a general conclusion about the impact of taxation cannot be made.

The comparison of the results of the investors' decision in a world with and without taxation shows that taxes do not necessarily influence the investors' behavior. It always depends on the individual case and on the design of the relevant tax system.

Resuming the well-known results in a world without taxation, the existence of collateral is redundant under perfect information.[35] Without considering any transaction costs, risk-neutral investors are indifferent to the assumption of liability. Taking a disparity in collateral valuation to the detriment of the investors into account, risk-neutral investors optimally refuse to provide any guarantee for risky debt capital. The securitization of loans can only be justified when taxation is considered.

Taxation can encourage or hamper the assumption of liability. The decision about the provision of a guarantee can change depending on tax-relevant valuation principles and tax rates. The tax cases explained above illustrate the impact of relevant tax parameters. In contrast to former results, it is shown that taxation can justify the existence of collateral even under perfect information. A positive tax effect (see case (iii')) can encourage the assumption of liability so that risk-neutral investors are no longer indifferent to the provision of guarantees. The tax benefit can principally even overcompensate a disadvantage due to a disparity in valuation.

Thus, taxation can set an incentive to provide collateral. The direction of the

[34] See e.g., Davydenko/Franks (2008), Steijvers et al. (2010), Blazy/Weill (2013).
[35] See e.g., Besanko/Thakor (1987a), Becker/Fuest (2007).

tax effects depends on several tax parameters, but is independent of a disparity in collateral valuation.

Additional research could integrate information asymmetry into this model and analyse eventual upcoming interdependencies between the collateral's taxation and private information on the provision of guarantees. Private information could be associated with the investors' risk, e.g. expressed by the individual success probability. Furthermore, taxable loss offset restrictions or costs for pledging collateral from the investors' point of view could possibly lead to additional tax effects in the model. Regarding different legal forms, the liability limitations are important but could theoretically be expressed by the provision of collateral as well. For further research it could also be interesting to clarify how the legislative framework and the design of different forms of liability could influence the assumption of liability.

5 Appendix

5.1 Maximal collateral

The effective amount of collateral is maximized if the creditors do not face any default risk and do not require a risk premium. Therefore, the payments to the creditors, also in state low, have to equal the debt capital plus the risk-free interest payment.

$$\begin{array}{rrcl} & D_{l-cv} & = & \lambda\left(1+r_f\right) \\ \Leftrightarrow & CF_l + \alpha C & = & \lambda\left(1+r_f\right) \\ \Leftrightarrow & C^{max} & = & \frac{1}{\alpha}\left(\lambda\left(1+r_f\right) - CF_l\right) \end{array} \tag{21}$$

In a world with taxation, the tax refund in state low is payed to the creditors (see equation (14)). The tax refund is transfered as cash to the creditors and thus, cannot be valued asymmetrically. Independent of symmetric or asymmetric valuation of the collateral, the maximal amount of effective collateral is lower ($C_\tau^{max} < C^{max}$):

$$\begin{array}{rrcl} & D_{l-cv}^{\tau} & = & \lambda\left(1+r_f\right) \\ \Leftrightarrow & CF_l + \alpha C - T_{cit-l} & = & \lambda\left(1+r_f\right) \\ \Leftrightarrow & C_\tau^{max} & = & \frac{1}{\alpha}\left(\lambda\left(1+r_f\right) - CF_l + T_{cit-l}\right) \end{array} \tag{22}$$

5.2 Risk premium without taxation

Using the creditors' calculus (equation (2)), the risk premium ($RP = i - r_f$) results in:

$$
\begin{array}{lrcl}
 & \lambda(1+r_f) & = & E[D_{s-cv}] \\
\Leftrightarrow & \lambda(1+r_f) & = & p_i\lambda(1+i)+(1-p_i)(CF_l+\alpha C) \\
\Leftrightarrow & \lambda(1+r_f) & = & p_i\lambda(1+r_f)+p_i\lambda RP \\
 & & & +(1-p_i)(CF_l+\alpha C) \\
\Leftrightarrow & (1-p)[\lambda(1+r_f)-CF_l-\alpha C] & = & p_i\lambda RP \\
\Leftrightarrow & RP & = & \frac{1-p_i}{p_i}\cdot\frac{\lambda(1+r_f)-D_{l-cv}}{\lambda}
\end{array}
$$

5.3 Investors' decision without taxation

Using $RP = \frac{1-p_i}{p_i}\cdot\frac{\lambda(1+r_f)-CF_l-\alpha C}{\lambda}$, the future values in a world without taxation result in:

$$
\begin{array}{rcl}
FV_h & = & CF_h - D_h = CF_h - \lambda(1+i) \\
 & = & CF_h - \lambda(1+r_f) - \lambda\frac{1-p_i}{p_i}\cdot\frac{\lambda(1+r_f)-CF_l-\alpha C}{\lambda}
\end{array}
$$

and

$$
\begin{array}{rcl}
FV_l & = & CF_l - D_l = CF_l - (CF_l + C) \\
 & = & -C
\end{array}
$$

The derivative of the expected utility of the future values with respect to the collateral results in:

$$
\begin{array}{rcll}
\frac{\partial E[U(FV)]}{\partial C} & = & p_i U_h^{'}\left(\alpha\frac{1-p_i}{p_i}\right)+(1-p_i)U_l^{'}(-1) & \\
 & = & (1-p_i)\alpha U_h^{'}-(1-p_i)U_l & (23) \\
 & = & (1-p_i)\left(\alpha U_h^{'}-U_l^{'}\right) &
\end{array}
$$

For $\alpha = 1$ ($\alpha < 1$), the investors are indifferent about the provision of collateral (do not provide collateral).

5.4 Tax payments

The tax payments result as follows.

Corporation - firm level:

$$
\begin{array}{rcll}
T_{cit-h} & = & \tau_{cit}(CF_h - 1 - (D_h - \lambda)) & \\
 & = & \tau_{cit}(CF_h - 1 - \lambda i) & \\
 & = & \tau_{cit}(CF_h - 1 - \lambda r_f - \lambda RP) & (24) \\
 & = & \tau_{cit}\left(CF_h - 1 - \lambda r_f - \frac{1-p_i}{p_i}(\lambda I_0(1+r_f) - D_{l-cv})\right) &
\end{array}
$$

and

$$\begin{aligned} T_{cit-l} &= \tau_{cit}\left(CF_l - 1 - (D_l - \lambda) + (1-\beta)\,C\right) \\ &= \tau_{cit}\left(CF_l - 1 - (CF_l - T_{cit-l} + C - \lambda) + (1-\beta)\,C\right) \\ &= \tau_{cit}\left(CF_l - 1 + DG\right) \\ &= \tau_{cit}\left(CF_l - 1 - (CF_l - T_{cit-l} + \beta C - \lambda)\right) \\ &= -\tfrac{\tau_{cit}}{1-\tau_{cit}}\left(1 - \lambda + \beta C\right) \end{aligned} \tag{25}$$

Corporation - shareholder level:

$$\begin{aligned} T_{s-h} &= \tau_s\left(CF_h - D_h - T_{cit-h} - (1-\lambda)\right) \\ &= \tau_s\left(CF_h - 1 - (D_h - \lambda) - \tau_{cit}\left(CF_h - 1 - (D_h - \lambda)\right)\right) \\ &= \tau_s\left(1-\tau_{cit}\right)\left(CF_h - 1 - (D_h - \lambda)\right) \\ &= \tau_s\left(1-\tau_{cit}\right)\left(CF_h - 1 - \lambda r_f - \tfrac{1-p_i}{p_i}\left(\lambda I_0\left(1+r_f\right) - D_{l-cv}\right)\right) \end{aligned} \tag{26}$$

In state low, the payment to the creditors is partly done by the corporation itself and partly (in the amount of the called collateral) by the shareholders. In equation (27), $D_l = CF_l - T_{cit-l} + C$ has to be adjusted for the tax base by the amount of the collateral. By using (8) the tax payment results in:

$$\begin{aligned} T_{s-l} &= \tau_s\left(CF_l - D_l + C - T_{cit-l} - (1 - \lambda + \gamma C)\right) \\ &= \tau_s\left(CF_l - D_l - T_{cit-l} - (1-\lambda) + C\left(1-\gamma\right)\right) \\ &= \tau_s\left(CF_l - (CF_l - T_{cit-l} + C) + C - T_{cit-l} - (1 - \lambda + \gamma C)\right) \\ &= -\tau_s\left(1 - \lambda + \gamma C\right) \\ &= -\tau_s\left(1-\lambda\right) - \tau_s \gamma C \end{aligned} \tag{27}$$

Corporation - total:

$$T_{c-h} = T_{cit-h} + T_{s-h} = \tau\left(CF_h - 1 - (D_h - \lambda)\right) \tag{28}$$

Using $D_l = CF_l - T_{cit-l} + C$ leads to

$$\begin{aligned} T_{c-l} &= T_{cit-l} + T_{s-l} \\ &= \tau\left(CF_l - 1 - (D_l - \lambda)\right) + \tau_{cit}\left(1-\tau_s\right)C\left(1-\beta\right) + \tau_s C\left(1-\gamma\right) \\ &= \tau\left(CF_l - 1 - (CF_l - T_{cit-l} + C - \lambda)\right) \\ &\quad + \tau_{cit}\left(1-\tau_s\right)\left(1-\beta\right)C + \tau_s\left(1-\gamma\right)C \\ &= \tau\left(CF_l - 1 - (CF_l - T_{cit-l} - \lambda)\right) + \beta C \tau_{cit}\left(1-\tau_s\right) + \gamma C \tau_s \\ &= -\tfrac{\tau}{1-\tau_{cit}}\left(1-\lambda\right) - C\tfrac{\beta\tau_{cit} + \gamma\tau_s\left(1-\tau_{cit}\right)}{1-\tau_{cit}} \end{aligned} \tag{29}$$

5.5 Risk premium with taxation

In state low the tax refund on the firm level is additionally payed to the creditors. The risk premium is lower than in a world without taxation for every $T_{cit-l} < 0$.

$$\begin{aligned} RP^{\tau} &= \frac{1-p_i}{p_i} \cdot \frac{\lambda(1+r_f)-D_l}{\lambda} \\ &= \frac{1-p_i}{p_i} \cdot \frac{\lambda(1+r_f)-CF_l-\alpha C+T_{cit-l}}{\lambda} \\ &= \frac{1-p_i}{p_i} \cdot \frac{\lambda(1+r_f)-CF_l-\alpha C-\frac{\tau_{cit}}{1-\tau_{cit}}(1-\lambda+\beta C)}{\lambda} \end{aligned} \tag{30}$$

5.6 Investors' decision with taxation

Using $RP^{\tau} = \frac{1-p_i}{p_i} \cdot \frac{\lambda(1+r_f)-CF_l-\alpha C+T_{cit-l}}{\lambda}$ the future values in a world with taxation result in:

$$\begin{aligned} FV_h^{\tau} &= CF_h - D_h - T_{c-h} \\ &= CF_h\,(1-\tau) + \tau - \lambda\,(1+r_f\,(1-\tau)) - \\ &\quad -(1-\tau)\,\tfrac{1-p_i}{p_i}\left[\lambda\,(1+r_f) - CF_l - \alpha C - \tfrac{\tau_{cit}}{1-\tau_{cit}}\,(1-\lambda+\beta C)\right] \end{aligned}$$

and

$$\begin{aligned} FV_l^{\tau} &= CF_l - D_l - T_{c-l} \\ &= CF_l - (CF_l + C - T_{cit-l}) - T_{cit-l} - T_{s-l} \\ &= -C - T_{s-l} \\ &= -C + \tau_s\,(1-\lambda) + \tau_s\gamma C \end{aligned}$$

The derivative of the expected utility of the future value with respect to the collateral results in:

$$\begin{aligned} \frac{\partial E[U(FV^{\tau})]}{\partial C} &= p_i U_h^{'}\left(\alpha\tfrac{1-p_i}{p_i} - \tau\alpha\tfrac{1-p_i}{p_i} + \tfrac{\tau_{cit}(1-\tau)}{1-\tau_{cit}}\beta\right) \\ &\quad + (1-p_i)\,(-1+\tau_s\gamma) \\ &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ &\quad + U_h^{'}\,(1-p_i)\,[-\tau\alpha + \beta\tau_{cit}\,(1-\tau_s)] \\ &\quad + U_l^{'}\,(1-p_i)\,\tau_s\gamma \end{aligned} \tag{31}$$

The decision on the provision of collateral depends on the tax parameters.

Tax cases without valuation haircut $\alpha = 1$

(i) $\beta = \gamma = 1$

$$\begin{aligned}\frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ &\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\ &= 0\end{aligned}$$

$C^* = indifferent$

(ii) $\beta = \gamma < 1$

$$\begin{aligned}\frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ &\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\ &= U_h^{'}(1-p_i)\left(-\tau + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma\right) \\ &= -U_h^{'}(1-p_i)\tau(1-\beta) < 0\end{aligned}$$

$C^* = 0$

(iii) $\beta \neq \gamma$

$$\begin{aligned}\frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ &\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\ &= U^{'}(1-p_i)\left[-\tau + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma\right]\end{aligned}$$

$C^* = ambiguous$

(iii') $\beta = 1 < \gamma$

$$\begin{aligned}\frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\ &\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\ &= U_h^{'}(1-p_i)\left[-\tau + \tau_{cit}(1-\tau_s) + \tau_s - \tau_s + \tau_s\gamma\right] \\ &= U_h^{'}(1-p_i)\left(-\tau + \tau_{cit}(1-\tau_s) + \tau_s\gamma - \tau_s(\gamma-1) + (\gamma-1)\right) \\ &= U_h^{'}(1-p_i)\tau_s(\gamma-1) > 0\end{aligned}$$

$C^* = C_{\tau}^{max}$

Tax cases with valuation haircut $\alpha < 1$

(i) $\beta = \gamma = 1$

$$\begin{aligned}
\tfrac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\
&\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)\left[-\tau\alpha + \tau_{cit}(1-\tau_s) + \tau_s\right] \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)\tau(1-\alpha) \\
&= -U_h^{'}(1-p_i)(1-\alpha) + U_h^{'}(1-p_i)\tau(1-\alpha) \\
&= -U_h^{'}(1-p_i)(1-\alpha)(1-\tau) < 0
\end{aligned}$$

$C^* = 0$

(ii) $\beta = \gamma < 1$

$$\begin{aligned}
\tfrac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\
&\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma\right] \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)\left[-\tau\alpha + \tau - \tau + \beta\tau\right] \\
&= -U_h^{'}(1-p_i)(1-\alpha) + U_h^{'}(1-p_i)\tau(1-\alpha) - U_h^{'}(1-p_i)\tau(1-\beta) \\
&= -U_h^{'}(1-p_i)(1-\alpha)(1-\tau) - U_h^{'}(1-p_i)\tau(1-\beta) < 0
\end{aligned}$$

$C^* = 0$

(iii) $\beta \neq \gamma$

$$\begin{aligned}
\tfrac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\
&\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\
&\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma - \tau + \tau\right] \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) + U_h^{'}(1-p_i)(-\tau\alpha + \tau) \\
&\quad + U_h^{'}(1-p_i)(-\tau + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma) \\
&\quad + U_h^{'}(1-p_i)(-\tau + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma) \\
&= -U_h^{'}(1-p_i)(1-\alpha)(1-\tau) \\
&\quad + U_h^{'}(1-p_i)(-\tau + \beta\tau_{cit}(1-\tau_s) + \tau_s\gamma) \gtrless 0
\end{aligned}$$

(iii') $\beta = 1 < \gamma$

$$\begin{aligned}
\frac{\partial E[U(FV^{\tau})]}{\partial C} &= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\
&\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \beta\tau_{cit}(1-\tau_s)\right] + U_l^{'}(1-p_i)\tau_s\gamma \\
&= (1-p_i)\left(\alpha U_h^{'} - U_l^{'}\right) \\
&\quad + U_h^{'}(1-p_i)\left[-\tau\alpha + \tau_{cit}(1-\tau_s) + \tau_s\gamma - \tau_s(\gamma-1) + \tau_s(\gamma-1)\right] \\
&= -U_h^{'}(1-p_i)(1-\alpha) + U_h^{'}(1-p_i)\left[-\tau\alpha + \tau + \tau_s(\gamma-1)\right] \\
&= -U_h^{'}(1-p_i)(1-\alpha) + U_h^{'}(1-p_i)\tau(1-\alpha) + U_h^{'}(1-p_i)\tau_s(\gamma-1) \\
&= -U_h^{'}(1-p_i)(1-\alpha)(1-\tau) + U_h^{'}(1-p_i)\tau_s(\gamma-1) \gtrless 0
\end{aligned}$$

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