Financial Leasing and the Pie Approach: Tax Asymmetries and Depreciation

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In dit artikel bestuderen we belastingvoordelen die er kunnen verbonden zijn aan financiële leasing in vergelijking met schuldfinanciering. Daarbij bekijken we zowel het Belgische systeem van financiële leasing waarbij de leasingnemer het geleasde goed afschrijft, als het Amerikaanse systeem dat aan de lessor het recht tot afschrijven toekent. We tonen aan dat, onder vereenvoudigde perfecte markt omstandigheden, belastingasymmetrieën tussen leasinggever en financier verantwoordelijk zijn voor eventuele voor- of nadelen van Belgische financiële leasing in vergelijking met schuldfinanciering. Verder laten we zien dat deze conclusie niet meer geldig is voor het Amerikaanse systeem, omdat belastingasymmetrieën tussen leasinggever en leasingnemer in dit geval eveneens meespelen.

Introduction

In DURINCK et al. (1990) a pie approach to capital structure was used in order to see how the way of financing, in particular financial leasing, influences the distribution of cash flows, generated by investment projects, between the government and the final beneficiaries, i.e. the personal security holders. In the present paper we reformulate this perpetuity model in a finite time context so that only part of the payments to debtholders will be taxable or tax deductible interest. We also include a bank as financial intermediary between the investing firm and the individual security holders. Furthermore, we insert depreciation into our model and study, next to the American system of financial leasing, also the Belgian leasing system, in which the lessee is considered to be the fiscal owner of
the invested asset and may write it off for tax purposes. We show that, unless there are tax asymmetries between bank and lessor, bank financing and Belgian leasing are equivalent alternatives under our perfect market hypotheses. American leasing might be superior to bank financing (even without these tax asymmetries between bank and lessor) if the lessor has a higher corporate tax rate than the lessee, because of the larger value of the depreciation tax shields to a lessor in a higher tax bracket. It is shown that this reason for the advantage of American leasing heavily relies on the assumption that tax losses can be sold by the lessor, or matched against other taxable income.

Since it is our intention to get an as clear as possible basic insight in the way how financing methods and tax asymmetries can influence the distribution of taxable income and taxes, we purposely exclude all imperfections but corporate and personal taxes in a simplified form. For the same reason, we only consider depreciation as a non-cash tax deduction. This can serve as a starting point for a deeper understanding of the value of financial leasing when several imperfections are introduced.

The Pie Approach to Bank Financing and Financial Leasing

We take the same assumptions as in DURINCK et al. (1990), i.e. capital markets are perfect, but for the existence of corporate taxes and personal taxes on debt income.

Consider a firm having the opportunity at time 0 to invest in an asset that generates future incremental operating cash flows $X_t$ at time $t$ for $t = 1, \ldots, n$. We will denote the multidimensional cash flow $(X_1, \ldots, X_n)$ by $X$ and the value of $X$ by $V[X]$. The investment requires an initial outlay $I$. The firm has the choice between buying the asset and financing the purchase price with a mixture of debt and equity, or leasing the asset from a lessor. Contrary to the assumptions made in DURINCK et al. (1990) we suppose that the investing firm does not obtain its debt financing directly from personal investors, but that it borrows from a bank, which at its turn is financed by equityholders and personal debtholders. We further

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1 He can however only deduct the interest part of the lease rentals from his taxable earnings.

2 It is assumed that personal interest income on debt is taxed at a uniform rate across investors, while equity income is not taxed at all at the personal level.
assume that product markets are perfect so that the investment cost I is the same for any investor. Suppose also that whether the asset is leased or bought, the user obtains the same benefits from it, i.e. the asset is leased for its whole economic life time and has no salvage value after the lease expires.

Analogously with DURINCK et al. (1990), we obtain the following distributions of the total pie $X$ under the two alternatives.

*Purchase Alternative*

\[(1) \quad X = D_P + R_P + P_P + Tc_P\]
\[\quad = D_P + F_P + Tc_P\]

where $D_P =$ payments by the purchaser to his equityholders,
$R_P =$ interest payments by the purchaser to the bank,
$P_P =$ principal payments by the purchaser to the bank,
$F_P =$ $R_P + P_P =$ total payments by the purchaser to the bank,
$Tc_P =$ corporate taxes paid by the purchaser.

All cash flows are incremental with respect to not undertaking the investment, and they are multidimensional (for example $D_P = (D_1^P, \ldots , D_n^P)$).

$F_P$ is received by the bank and divided into payments to its debt- and equityholders by its financing decision:

\[(2) \quad F_P = D_b + R_b + P_b + Tc_b\]
\[\quad = D_b + F_b + Tp_b + Tc_b\]

where $D_b =$ payments by the bank to its equityholders,
$R_b =$ interest payments by the bank to its bondholders,
\[ P_b = \text{principal payments by the bank to its bondholders,} \]
\[ F_b = (1 - \tau_B) R_b + P_b = \text{payments to bondholders after personal taxes (} \tau_B \text{ is the tax rate on personal interest income),} \]
\[ Tp_b = \tau_B R_b = \text{personal taxes paid by the bank's bondholders,} \]
\[ Tc_b = \text{corporate taxes paid by the bank.} \]

Assuming that personal debtholders will pay the market value of the claims they receive, we have that

\[ (3) \quad B_0^b = V[F_b], \]

i.e. the nominal amount of borrowing by the bank at time zero \( B_0^b \) is equal to the present value of the claims of the bank's bondholders. The net present value \( V^b \) of the project to the bank equals \(^3\)

\[ (4) \quad V^b = V[D^b] + V[F_b] - B_0^p \]
\[ = V[D^b] - (B_0^p - B_0^b) \]

where \( B_0^p \) is the nominal value at time zero of the loan given by the bank to the purchaser.

(4) expresses that the value to the bank is equal to the value of the incremental payments to its equityholders minus the amount these equityholders have to supply at time zero, \( B_0^p - B_0^b \). We will assume that by competition the amount of debt financing \( B_0^p \) the bank supplies to the purchaser, adjusts in such a way that the net present value to the bank \( V^b \) reduces to zero. Hence by (4) and (2)

\(^3\) Schall's value additivity principle is used here (see SCHALL (1972)).

So, for a given value \( V[F^p] \), i.e. a given value of the cash inflows, the amount of debt financing the bank can give depends on how large the tax leaks \( Tc^b \) and \( Tp^b \) are. These tax leaks are determined by the bank's tax bracket \( \tau_b \), by its way of financing, by the tax rate on personal interest income \( \tau_B \), and by the allocation of \( F^p \) between interest and principal. The larger the tax leaks are, the larger is the cost of capital to the bank, leading to a lower amount of financing for given cash inflows. We will investigate this fact in greater detail later.

Since the value of the project to the bank \( V^b \) is assumed to be zero, the net present value \( V_P \) of the project to the purchaser is equal to the value of the cash flows finally received (or paid) by equity- and debtholders in the private sector, i.e.

\[
(6) \quad V_P = V[D^P] + V[D^b] + V[F^b] - I
\]

\( V^b \) payments (after tax) to equityholders purchaser \( V^b \) payments (after tax) to security holders bank I input by the private sector

Using (5) \( V_P \) can also be written as

\[
(7) \quad V_P = V[D^P] - (I - B_0^P)
\]

or the value to the purchaser is equal to the value of the incremental payments to his equityholders minus the amount these equityholders have to supply at time zero \( I - B_0^P \).

Finally, using equations (1) and (2), (6) can be rewritten as

\[
\]

Equation (8) shows that the value \( V_P \) is determined by the tax leaks. Any feasible way of dividing the total pie \( X \) (i.e. any feasible way of financing) leading to the smallest tax leaks, will be the most favourable one.
The next scheme gives a synthesis of the foregoing pie distribution.

**FIGURE 1**

<table>
<thead>
<tr>
<th>t = 0</th>
<th>t = 1, 2,...</th>
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<tbody>
<tr>
<td>equityholders</td>
<td>equityholders</td>
</tr>
<tr>
<td>I - B_o^b</td>
<td>D^p</td>
</tr>
<tr>
<td>I</td>
<td>purchaser</td>
</tr>
<tr>
<td>B_o^p</td>
<td>B_o^b</td>
</tr>
<tr>
<td>B_o^p</td>
<td>bank</td>
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<td></td>
<td>bondholders</td>
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</tbody>
</table>

*Lease Alternative*

(9) \[ X = D^e + L + T_c^e \]

where \( D^e \) = payments by the lessee to his equityholders,

\( L \) = payments to the lessor,

\( T_c^e \) = corporate taxes paid by the lessee.

It is assumed that except for the lease claims, all claims on the incremental cash flows generated by the project are equity claims (i.e. the lessee does not take any additional debt).
By the financing decision of the lessor, L is further divided into payments to his debt- and equityholders:

\[
L = D^r + R^r + P^r + Tc^r
\]

\[
= D^r + Fr + Tp^r + Tc^r
\]

where

- \( D^r \) = payments by the lessor to his equityholders,
- \( R^r \) = interest payments by the lessor to his bondholders,
- \( P^r \) = principal payments by the lessor to his bondholders,
- \( Fr \) = \((1 - \tau_B) R^r + P^r\) = payments to bondholders after personal taxes,
- \( Tp^r \) = \( \tau_B R^r \) = personal taxes paid by the lessor’s bondholders,
- \( Tc^r \) = corporate taxes paid by the lessor.

Since personal debtholders pay the market value of the claims they receive, we have as in formula (3)

\[
B_0^r = V[F^r]
\]

i.e. at time zero the nominal amount of the borrowing by the lessor \( B_0^r \) is equal to the present value of the claims of the lessor’s bondholders. The net present value \( V^r \) of the project to the lessor equals

\[
V^r = V[D^r] + V[F^r] - I
\]

\[
= V[D^r] - (I - B_0^r)
\]

since the amount of financing supplied by the lessor to the lessee is equal to the investment cost \( I \).

From (12) we see that the value to the lessor is equal to the value of the incremental payments to his equityholders minus the amount these equity-
holders have to invest at time zero, \( I - B_0^r \). Similar to the case of the bank under the purchase alternative, we assume that by competition the level of the lease premiums \( L \) adjusts in such a way that the net present value to the lessor \( V^r \) reduces to zero. Hence by (12) and (10)

\[
\]

The equilibrium lease premium (which under our hypotheses equals the breakeven lease premium to the lessor, i.e. the value of \( L \) giving him a zero net advantage) depends on how large the tax leaks \( Tc^r \) and \( Tp^r \) are. The larger they are, the larger the equilibrium \( L \) will be. These tax leaks are determined by the lessor's tax bracket \( \tau_r \), by its way of financing, by the tax rate on personal interest income \( \tau_B \), and by the system of financial leasing. We will discuss this later.

Since the value of the project to the lessor \( V^r \) is assumed to be zero, the net present value \( V^e \) of the project to the lessee is equal to the value of the cash flows finally received (or paid) by equity- and debtholders in the private sector, i.e.

\[
(14) \quad V^e = V[D^e] + V[D^r] + V[F^r] - I \\
\text{payments (after tax) to} \quad \text{payments (after tax) to} \quad \text{input by the private} \\
\text{equityholders lessee} \quad \text{security holders lessor} \quad \text{sector}
\]

Using (13) \( V^e \) can also be written as

\[
(15) \quad V^e = V[D^e]
\]

or the value to the lessee is equal to the value of the incremental payments to his equityholders, since they don't have to give any financing at time zero. Finally, using the equations (9) and (10), (14) can be rewritten as

\[
\]

Equation (16) shows that the value \( V^e \) is determined by the tax leaks. Maximizing value is equivalent to minimizing tax leaks.
A synthesis of the foregoing is concluded in the next scheme (where the dotted arrow means that although the lessor invests directly in the asset, it can be seen as a financing operation through the lessee, receiving a cash flow I from the lessor and using this inflow to finance the investment):

**FIGURE 2**

\[
\begin{align*}
& \text{t = 0} \\
& \text{equityholders} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{I} \\
& \quad \downarrow \\
& \quad \text{lessee} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{B}_0^r \\
& \quad \downarrow \\
& \quad \text{bondholders} \\
& \quad \downarrow \\
& \quad \text{I} \\
& \quad \downarrow \\
& \quad \text{lessee} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{D}^e \\
& \quad \downarrow \\
& \quad \text{lessee} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{X} \\
& \quad \downarrow \\
& \quad \text{government} \\
& \quad \downarrow \\
& \quad \text{Tc}^e \\
\end{align*}
\]

\[
\begin{align*}
& \text{t = 1, 2,...} \\
& \text{equityholders} \\
& \quad \downarrow \\
& \quad \text{D}^e \\
& \quad \downarrow \\
& \quad \text{lessee} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{L} \\
& \quad \downarrow \\
& \quad \text{lessor} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{Tc}^r \\
& \quad \downarrow \\
& \quad \text{bondholders} \\
& \quad \downarrow \quad \downarrow \\
& \quad \text{R}^r + \text{P}^r \\
& \quad \downarrow \\
& \quad \text{bondholders} \\
& \quad \downarrow \\
& \quad \text{Tp}^r = \tau_B R^r \\
& \quad \downarrow \\
& \quad F^r = (1-\tau_B)R^r + P^r
\end{align*}
\]

*The Net Advantage of Leasing*

The net advantage of leasing is the difference between the value of the cash flows received by the final security holders under the lease and under the buy-borrow alternative. But since we assumed that the value to the bank \( V^b \) and the value to the lessor \( V^r \) are equal to zero, the net advantage of leasing also equals \( V^e - V^p \), which is the net advantage of leasing to the
lessee 4. By (8) and (16) we obtain for the net advantage of leasing

\[ NAL = V^e - V^p \]


This is the central result, showing that leasing is advantageous if the total value of the tax leaks under the lease alternative is smaller than the value of the leaks under the buy-borrow alternative. The financing method, which minimizes the value of the tax leaks, will thus maximize the value of the project 5.

Taxable Earnings and the Two Different Leasing Systems

Although most countries agree on the idea that an asset, leased under a financial lease, is in fact economic property of the lessee and should be capitalized on the asset side of the balance sheet with a related lease obligation on the liability side, the tax treatment can still be different. In the U.S. for example, the lessor is treated as the owner of the asset by the tax authorities. This means that he can deduct the depreciation of the asset from his taxable income, while the whole lease payment is treated as a gain. The lessee is allowed to deduct the lease rentals in its totality as operating expenses. Originally, this was the situation in Belgium too. However, since assessment year 1986 (for large companies already since assessment year 1983) 6 the lessee is considered to be the fiscal owner in Belgium. He is allowed to depreciate an asset leased under a financial leasing contract. Next to the depreciation, the interest part of the lease payments will be deductible from his taxable earnings.

We will now look at three different financing methods, namely the buy-borrow alternative and the two systems of financial leasing. Each of these financing methods will lead to a certain distribution of the total (incre-

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4 See DURINCK et al. (1990). Obviously, the net advantage of leasing to the lessor, which is equal to the value of the project to the lessor \( V^e \), equals zero under our hypotheses.

5 By value of the project we mean the total value of the cash flows, finally received by the private sector minus the input by this sector. Since the value to the bank and the value to the lessor are assumed to be zero however, it is also equal to the value of the project to the firm doing the investment (the purchaser or the lessee).

6 See for example INGELBRECHT and VERVAET (1989).
mental) taxable earnings over different tax regimes: the tax regime of the investing firm (purchaser, lessee) with a tax bracket $\tau$, and the tax regimes of bank, lessor and personal debtholders with tax rates equal to respectively $\tau_b$, $\tau_r$ and $\tau_B$. With total (incremental) taxable earnings we mean the sum of the (incremental) taxable earnings from all the parties involved in the project. Hereafter we will show that the total taxable earnings are equal to $X - DP$, i.e. the difference between the operating cash flow $X$ and the depreciation deductions $DP = (DP_1, DP_2, \ldots)$ \(^7\). Assuming that the depreciation scheme is only related to the invested asset and does not depend on the firm writing it off, the total taxable earnings are independent of the financing method, merely redistributing the earnings over different tax regimes. The way of financing, directing the taxable earnings to the most favourable tax regimes, will be the best choice to minimize taxes and hence to maximize the value of the project.

If the investing firm is all equity financed, it is clear that its taxable earnings are equal to $X - DP$. Let us now look at the distribution of the taxable earnings caused by the investment project, for our three financing methods. Using the same notation as in the former section we have for the purchase alternative

\begin{align}
(18) \quad & E_P = X - DP - RP, \\
& E^b = RP - R^b, \\
& E^B = R^b
\end{align}

where $E_P$, $E^b$ and $E^B$ stand for the (incremental) taxable earnings of the purchaser, bank and bondholders of the bank. Formula (18) expresses that the interest payments are tax deductible expenses for the payer and taxable income to the receiver, and that it is of course the purchaser who may depreciate the asset.

For the American leasing system one has

\begin{align}
(19) \quad & E^c = X - L, \\
& E^r = L - DP - R^r, \\
& E^B = R^r
\end{align}

\(^7\) To simplify the analysis, we won't consider investment tax credits and only study depreciation as a non cash tax deduction.
where $E^e$, $E^r$ and $E^B$ denote the incremental taxable earnings of the lessee, lessor and bondholders of the lessor under the American leasing system. The lease rentals are tax deductible expenses to the lessee, but taxable income for the lessor. The lessor is allowed to depreciate the asset and can also deduct the interest payments to his bondholders from his taxable income.

Finally, we obtain for the Belgian leasing system

$$
E^e = X - DP - RL = X - L + DL - DP,
$$

$$
E^r = RL - R^r = L - DL - R^r,
$$

$$
E^B = R^r
$$

where $E^e$, $E^r$ and $E^B$ denote the incremental taxable earnings of the lessee, lessor and bondholders of the lessor under the Belgian leasing system, and RL resp. DL are equal to the interest resp. principal parts of the lease premiums as accepted by the tax authorities. We assume that RL and DL are determined by the repayment schedule of the implicit loan associated with the lease payments (see next section) which globally agrees with reality, apart from the fact that lease rentals are generally due in advance, while we assume them to be paid at the end of the period.

By comparing (19) with (20) one sees that the only formal difference between the two leasing systems concerning the taxable earnings, is the transfer of a taxable income $DP - DL$ from lessee to lessor. Total taxable earnings of each of the leasing systems are equal and also equal to the total taxable earnings of the purchase alternative. If all tax rates are equal, and if all taxable earnings are positive (or in case they are negative, can be matched against other taxable income, causing negative incremental tax leaks) total taxes will be the same for any financing alternative. Since the value of the project depends on the tax leaks as shown before $^8$, no financing method will be preferable above any other. The total value of the taxes is equal to $V [\tau (X - DP)]$ (where $\tau$ is the tax rate) and the value of the project is given by (independent of the financing method)

$$
V_p = V^e = V [X] - I - V [\tau (X - DP)]
$$

$$
= (1-\tau) V [X] + \tau V [DP] - I
$$

$^8$ See equations (8) and (16).
using (8) or (16). Notice that the value of the project to an all equity financed firm is also given by formula (21).

In order for leasing (or another financing method) to be more valuable than other ways of pie distribution, there must exist some tax asymmetries, causing different tax leaks for different distributions. We will investigate this in the next section.

Tax Asymmetries and the Value of Leasing

In this section we will develop numerical examples for a two period model, which will enable us to get insight in the distribution of taxable earnings and taxes for different assumptions about the way of financing, the corporate and personal tax rates, and the amount of personal debt in the system.

We assume that all cash flows under consideration can be valued using the discount rate \( r_0 \). This assumption will enable us to study the distribution and the timing of the taxes, without having to consider differences in risk. In this situation, the required rate of return on equity equals \( r_0 \), but the interest rate on personal debt \( r_B \) is obtained by grossing up \( r_0 \) by the tax rate on personal interest income \( \tau_B \), i.e.

\[
(22) \quad r_B = r_0 / (1 - \tau_B)
\]

The after-tax required rate of return is thus equal to \( r_0 \) for any individual investor.

We first show that the breakeven lease premium \( L \) of a Belgian lessor (i.e. the premium which gives him a zero net advantage) and also the corporate tax leak \( Tc_f \), are determined by the corporate tax rate \( \tau_c \) of the lessor, the tax rate on personal bond income \( \tau_B \), and the amount of personal debt in the system. The amount of personal debt is not just determined by the nominal value of the loan at time zero \( B_{0r} \), but also by the outstanding debt at any future time period (i.e. by the repayment schedule). If the re-

\footnote{This will happen for instance in a risk free world where \( r_0 \) is the time value of money.}
payment schedule \( P^r = (P^r_1, P^r_2, \ldots) \) is known, interests \( R^r \) are known as well \(^{10}\) and the personal tax leak is then equal to

\[
(23) \quad Tp^r = \tau_B R^r
\]

As mentioned before, we assume that the taxable interest part of the lease rentals \( RL \) is determined by the implicit interest rate \( i \) of the lease, which can be obtained as the solution of the following equation

\[
(24) \quad I = \sum_{t=1}^{n} \frac{L}{(1+i)^t}
\]

where \( I = \) investment outlay,

\[ n = \text{lease period}, \]

\[ L = \text{lease rentals}. \]

Notice that we assume the lease rentals to be level, i.e. \( L_t = L \) for \( t = 1, \ldots, n \).

For a given amount of personal debt (for example for given interest payments \( R^r \)) and for given tax rates \( \tau_r \) and \( \tau_B \), the breakeven value of \( L \) and the associated implicit interest rate \( i \) can now be obtained from equation (13):

\[
V [L] = I + V [Tc^r] + V [Tp^r]
\]

expressing that the net present value to the lessor \( V^r \) is equal to zero. In this section we will just give numerical examples. For a detailed derivation of the above result we refer to appendix A. Once the equilibrium \( L \) is known, all taxable earnings can be calculated as given by formula (20), hence determining the tax leaks and the value of the project under the Belgian leasing alternative.

In appendix B we show how an equilibrium value \( L \) for American

\(^{10}\) The interest rate on personal debt \( r_B \) is given by formula (22).
leasing can be obtained, also starting from equation (13). Taxable earnings are now given by formula (19).

Finally, let us look at bank financing. It is clear that, as for Belgian leasing, the corporate tax rate $\tau_B$ of the bank, the tax rate on personal bond income $\tau_B$, and the amount of personal debt in the system will all have their influence on the cost of bank financing $r_B$, i.e. the interest rate the bank requires for the loan to the purchaser. This cost will however only be uniquely determined as in the leasing situation if we make assumptions about the repayment schedule of this loan. Since our aim is primarily a comparison between leasing and bank financing, we will use the equivalent loan approach of Myers et al. (1976) and Franks and Hodges (1978) where the cash outflows of debt financing are related to those of the leasing alternative. The initial amount of the loan $B_0^P$ and its repayment schedule are chosen in such a way that the equityholders of the investing firm receive the same income under the two alternatives, i.e.

\[
(25) \quad D_p = D^e (D^p_t = D^e_t \text{ for } t = 1,2,\ldots)
\]

or equivalently

\[
(26) \quad F_p + Tc_p = L + Tc^e
\]

Under this assumption, the position of the equityholders of the investing firm is the same at any future time period $t = 1,2,\ldots$ whether the asset is leased or bought. The net advantage of leasing is then given by

\[
(27) \quad \text{NAL} = V^e - V_p = I - B_0^P
\]

using equations (7), (15) and (25).

Leasing is advantageous if the investing firm can only borrow a smaller amount $B_0^P$ from the bank than the financing it obtains from the lessor, namely the investment outlay $I$, against the same cash outflows under the
two alternatives\textsuperscript{11}. We explain in appendix C that it is now possible to get a complete picture of the distribution of the taxable earnings defined by formula (18).

As mentioned before, we will work with a two period model, i.e. \( n = 2 \). The cost price of the asset is equal to \( I = 1000 \), and the depreciation is straight line, i.e. \( DP_1 = DP_2 = 500 \). The incremental operating cash flows, generated by the investment, are assumed to be known with certainty and are given by \( X_1 = X_2 = 650 \). Finally, all cash flows can be valued using the discount rate \( r_0 = 0.06 \). We now work out several examples for different assumptions about the tax rates and the amount of personal debt financing.

Case 1: \( \tau_B = \tau = \tau_r = \tau_b \)

Assume for example that all tax rates are equal to 0.4 and that the amount of personal debt is given by an initial loan amount of 600 and a constant repayment schedule. It then follows from equation (22) that the cost of personal debt is equal to \( r_B = r_0/(1-\tau_B) = 0.06/0.6 = 0.10 \). Hence,

\[
R_1^r = 0.1 \times 600 = 60 \text{ and } R_2^r = 0.1 \times 300 = 30
\]

We find for the implicit interest rate and the associated equilibrium lease rentals of Belgian leasing (see appendix A):

\[
i = 0.10 \text{ and } L = \frac{(1+i)^2}{2+i} \text{ I = 576.19}
\]

Consequently,

\[
RL_1 = 100, \ DL_1 = 476.19, \ RL_2 = 52.38, \ DL_2 = 523.81
\]

\textsuperscript{11} Instead of applying the equivalent loan principle one can also compare leasing with bank financing where another amount of debt is taken at time zero or another repayment schedule is followed than for the equivalent loan. For example, one can assume that also under the borrow alternative the bank precisely finances the investment cost. One then compares the value of two different financing methods, leasing and a particular way of bank financing, without taking account however of the different position in which the investing firm is placed.
The following table can readily be obtained now.

**TABLE 1.1**

<table>
<thead>
<tr>
<th></th>
<th>Taxable earnings</th>
<th>Tax rates</th>
<th>Taxes</th>
<th>Value of taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>period 1</td>
<td>period 2</td>
<td>period 1</td>
<td>period 2</td>
</tr>
<tr>
<td>Lessee</td>
<td>50</td>
<td>97.62</td>
<td>0.4</td>
<td>20.00</td>
</tr>
<tr>
<td>Lessor</td>
<td>40</td>
<td>22.38</td>
<td>0.4</td>
<td>16.00</td>
</tr>
<tr>
<td>Bondholders</td>
<td>60</td>
<td>30</td>
<td>0.4</td>
<td>24.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150.00</strong></td>
<td><strong>150.00</strong></td>
<td></td>
<td><strong>60.00</strong></td>
</tr>
</tbody>
</table>

The value of the taxes is obtained by discounting the taxes with the discount rate $r_0$, for example

$$V \left[ T c^e \right] = T c^e_1/(1+r_0) + T c^e_2/(1+r_0)^2$$

Comparing bank financing with the leasing alternative above, where the bank has the same amount of personal debt ($B_0^b = 600, P_1^b = P_2^b = 300$), leads to, using the equivalent loan principle (see appendix C):

$$r_b = i = 0.10 \text{ and } B_0^p = I = 1000$$

The repayment schedule is exactly the same as in the case of leasing and so is the distribution of taxable earnings and taxes. Even if the personal debt amount of the bank is different from that of the lessor, this will only change the distribution of taxable earnings between bank and bondholders, leaving total taxes and hence the value of the project unchanged.

For an American lessor we find under the same circumstances (see appendix B) that $L = 575.73$. The distribution of taxable earnings and taxes is given in the next table.
The equilibrium lease rental $L$ is less than in the Belgian leasing situation. The difference however is rather small in our example. If the asset was written off more quickly, i.e. if a degressive depreciation scheme was used, the equilibrium lease premium of a Belgian lessor would not alter but the equilibrium $L$ of an American lessor would be lower. The most important distinction between the two leasing systems is the timing of the taxable earnings. The depreciation scheme $DP$ is constant (in our example, but it could as well be degressive) while the repayment schedule $DL$ of the implicit loan associated with the Belgian lease rentals is an increasing scheme. It follows that the taxable income of a Belgian lessor (disregarding the personal debt) $RL = L - DL$ decreases while the income of an American lessor $L - DP$ remains constant (or increases if the depreciation scheme is degressive). The advantage obtained by an American lessor from deferring part of the taxes to a later time period, is passed on to the lessee in the form of lower lease rentals. Exactly the opposite holds for the American lessee who pays more taxes in the first period and less in the second than the Belgian lessee. The value of his taxes is also a bit higher than the value of the taxes from a Belgian lessee, namely $54.47 - 53.62 = 0.85$. Total taxes however remain the same in any period and the value of the project is not altered. There is only a transfer between tax leaks without altering the total tax leak. The tax loss of an American lessee in comparison with the Belgian lessee exactly equals the gain he obtains from the lowering of the lease rentals:

$$(576.19 - 575.73)/1.06 + (576.19 - 575.73)/(1.06)^2 = 0.85$$

For the equivalent loan alternative to the American leasing situation of Table 1.2.a we find (see appendix C):
\[ r_b = 0.10, \quad B_0^B = 1000, \quad P_1^D = 485.44, \quad P_2^D = 514.56 \]

The associated table of taxable earnings shows a similar distribution as in the Belgian leasing case. Total value however still remains the same.

**Table 1.2.b**

<table>
<thead>
<tr>
<th>Taxable earnings</th>
<th>Tax rates</th>
<th>Taxes</th>
<th>Value of taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>period 1</td>
<td>period 2</td>
<td>period 1</td>
</tr>
<tr>
<td>Purchaser</td>
<td>50</td>
<td>98.54</td>
<td>0.4</td>
</tr>
<tr>
<td>Bank</td>
<td>40</td>
<td>21.46</td>
<td>0.4</td>
</tr>
<tr>
<td>Bondholders</td>
<td>60</td>
<td>30</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td>150.00</td>
<td>150.00</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Let us now introduce some tax asymmetries.

**Case 2 : \( \tau_B < \tau = \tau_r = \tau_b \)**

Personal debt is treated favourably by the tax authorities in this case, and the financing method which uses the largest amount of personal debt will cause the smallest tax leaks. Assume for example that \( \tau = \tau_r = \tau_b = 0.4 \) and \( \tau_B = 0.25 \). The cost of personal debt is now equal to \( r_B = r_0/(1-\tau_B) = 0.08 \). For an amount of personal debt \( B_0^r = 600 \) and repayment schedule \( P_1^r = P_2^r = 300 \) we obtain in case of Belgian leasing

\[ i = 0.08816, \quad L = 567.05 \text{ and} \]

\[ RL_1 = 88.16, \quad DL_1 = 478.89, \quad RL_2 = 45.94, \quad DL_2 = 521.11 \]

The following tax distribution results.
TABLE 2.1.a

<table>
<thead>
<tr>
<th></th>
<th>Taxable earnings</th>
<th>Tax rates</th>
<th>Taxes</th>
<th>Value of taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>period 1</td>
<td>period 2</td>
<td>period 1</td>
<td>period 2</td>
</tr>
<tr>
<td>Lessee</td>
<td>61.84</td>
<td>104.06</td>
<td>0.4</td>
<td>24.74</td>
</tr>
<tr>
<td>Lessor</td>
<td>40.16</td>
<td>21.94</td>
<td>0.4</td>
<td>16.06</td>
</tr>
<tr>
<td>Bondholders</td>
<td>48</td>
<td>24</td>
<td>0.25</td>
<td>12.00</td>
</tr>
<tr>
<td>Total</td>
<td>150.00</td>
<td>150.00</td>
<td>52.80</td>
<td>56.40</td>
</tr>
</tbody>
</table>

If the bank uses the same amount of personal debt \( B_0^b = 600, \quad P_1^b = P_2^b = 300 \) we obtain (using the equivalent loan principle)

\[ r_b = i = 0.08816 \quad \text{and} \quad B_0^P = i = 1000 \]

The repayment schedule is exactly the same as in the leasing case and the distribution of taxable earnings is given by table 2.1.a.

Assume now that the bank could take more personal debt, for example \( B_0^b = 800 \) and \( P_1^P = P_2^P = 400 \). We then have

\[ r_b = 0.08426 \quad \text{and} \quad B_0^P = 1003.33 \]

The repayment schedule is given by \( P_1^P = 481.06, \quad P_2^P = 522.27 \), and the following table can be obtained.
TABLE 2.1.b
Bank financing; $\tau_B = 0.25$, $\tau = \tau_b = 0.4$; $B_0^b = 800$, $P_1^b = P_2^b = 400$

<table>
<thead>
<tr>
<th></th>
<th>Taxable earnings</th>
<th>Tax rates</th>
<th>Taxes</th>
<th>Value of taxes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>period 1</td>
<td>period 2</td>
<td>period 1</td>
<td>period 2</td>
</tr>
<tr>
<td>Purchaser</td>
<td>65.46</td>
<td>105.99</td>
<td>0.4</td>
<td>26.18</td>
</tr>
<tr>
<td>Bank</td>
<td>20.54</td>
<td>12.01</td>
<td>0.4</td>
<td>8.22</td>
</tr>
<tr>
<td>Bondholders</td>
<td>64</td>
<td>32</td>
<td>0.25</td>
<td>16.00</td>
</tr>
<tr>
<td>Total</td>
<td>150.00</td>
<td>150.00</td>
<td>50.40</td>
<td>55.20</td>
</tr>
</tbody>
</table>

The cost of bank financing is smaller than the cost of leasing, and the advantage of leasing is given by formula (27)

$$\text{NAL} = I - B_0^P = 1000 - 1003.33 = -3.33$$

This is precisely equal to the decrease in the value of the taxes:

$$100.01 - 96.68 = 3.33$$

If the bank would take less personal debt, the opposite conclusion (leasing is advantageous) would hold.

In the present situation, it is the total amount of personal debt in the system that determines the total tax leaks. More personal debt leads to lower total tax leaks. It is not important how this personal debt amount is brought into the system (through a bank, through a lessor, or possibly by direct borrowing from the private sector), only the total amount of favourable personal debt counts.

For American leasing, there is a similar shift of taxable earnings between lessor and lessee and between time periods as in the first case. Since the tax rates of lessee and lessor are equal however, total tax leaks will be the same as for Belgian leasing if the same amount of personal debt is used.

In the following examples, we will assume that the amount of personal debt in the system is the same for any financing method (Belgian leasing, American leasing, bank financing) in order to discover the value of the
financing methods themselves under different tax asymmetries.

**Case 3: \( \tau_B < \tau_r, \tau_b < \tau \)**

Let \( \tau_B = 0.25, \tau_r = 0.4, \tau = 0.5 \). For a nominal loan amount \( B_0^r = 600 \) and repayment schedule \( P_1^r = P_2^r = 300 \), we obtain for Belgian leasing the same equilibrium lease premium \( L = 567.05 \) and the same taxable earnings as in table 2.1.a. The only difference is that the lessee is now in a higher tax bracket. His taxes are equal to

\[
Tc_1^e = 0.5 \times 61.84 = 30.92 \quad \text{and} \quad Tc_2^e = 0.5 \times 104.06 = 52.03
\]

and the value of his taxes

\[
V[Tc^e] = 30.92/(1.06) + 52.03/(1.06)^2 = 75.47
\]

The total value of all the tax leaks is thus given by

\[
75.47 + 22.97 + 16.66 = 115.10
\]

If the tax bracket of the bank \( \tau_b \) is equal to that of the lessor, bank financing will be completely equivalent to leasing and the repayment schedule of the equivalent loan is exactly the same as in the leasing case. Belgian leasing can be valuable however if there is a tax asymmetry between bank and lessor. Assume for example that \( \tau_b = 0.45 \). Then we have for the equivalent loan (assuming the same amount of personal debt)

\[
r_b = 0.09183, B_0^p = 997.37, P_1^p = 477.18, P_2^p = 520.20
\]

The values of the taxes are equal to

\[
V[Tc^p] = 73.05, V[Tc^b] = 28.02, V[Tp^b] = 16.66
\]

The cost of bank financing \((r_b = 0.09183)\) is higher than the cost of leasing \((i = 0.08816)\). More taxable earnings are transferred from the investing firm to the bank (caused by the larger interest payments) but the advantage obtained from this transfer is more than offset by the larger tax
rate of the bank in comparison with the lessor. The net advantage of leasing is given by

\[ \text{NAL} = I - B_0^D = 1000 - 997.37 = 2.63 \]

which is precisely equal to the increase in the value of the taxes for bank financing

\[ 73.05 + 28.02 + 16.66 - 115.10 = 117.73 - 115.10 = 2.63 \]

An opposite result would be obtained if \( \tau_b < \tau_r \).

For American leasing we find under the same assumptions as in the Belgian leasing case that \( L = 566.64 \). The next table gives the distribution of taxable earnings and taxes.

| TABLE 3.1 |
|---|---|---|---|---|
| **American leasing;** \( \tau_b = 0.25, \tau_r = 0.4, \tau = 0.5; B_0^r = 600, P_1^r = P_2^r = 300 \) | **Taxable earnings** | **Tax rates** | **Taxes** | **Value of taxes** |
| period 1 | period 2 | period 1 | period 2 |
| Lessee | 83.36 | 83.36 | 0.5 | 41.68 | 41.68 | 76.42 |
| Lessor | 18.64 | 42.64 | 0.4 | 7.46 | 17.06 | 22.22 |
| Bondholders | 48 | 24 | 0.25 | 12.00 | 6.00 | 16.66 |
| **Total** | 150.00 | 150.00 | 61.14 | 64.74 | 115.30 |

Table 3.1 shows that the transfer of the depreciation deduction from a lessee to a less heavily taxed lessor in the American leasing system has a net tax increasing result in comparison with Belgian leasing (115.30 - 115.10 = 0.20). The effect is very small in our example, but it would be larger if we had a faster depreciation scheme; first of all since the quicker writing off has got a more beneficial effect on the Belgian lessee in a higher tax bracket, than it has on the lessor in the American case; and secondly since the faster depreciation scheme causes the American equilibrium lease premium to be lower, so that less taxable earnings are transferred to the lower tax regime of the lessor. For the equivalent loan (with \( \tau_b = \tau_r \)) we find
\[ \tau_b = 0.08808, \quad B_0^P = 1000.10, \quad P_1^P = 489.28, \quad P_2^P = 510.82 \]

Bank financing is preferable above American leasing \((B_0^P > I)\), even for equal tax rates of bank and lessor and the same amount of personal debt, because of the lower beneficial tax effect of the depreciation deductions to a less heavily taxed lessor, compared with the purchaser. The disadvantage of leasing would be larger if the asset could be written off faster.

**Case 4 :** \(\tau_B < \tau < \tau_r, \tau_b\)

Let \(\tau_B = 0.25, \tau_r = 0.4, \tau = 0.35\). For a nominal loan amount \(B_0^r = 600\) and repayment schedule \(P_1^r = P_2^r = 300\), we obtain for Belgian leasing again the same \(L = 567.05\) and the same taxable earnings as in table 2.1.a. The taxes of the lessee are now equal to

\[ Tc_1^e = 0.35 \times 61.84 = 21.64 \quad \text{and} \quad Tc_2^e = 0.35 \times 104.06 = 36.42 \]

and the value of his taxes

\[ V[Tc^e] = 21.64/(1.06) + 36.42/(1.06)^2 = 52.83 \]

The total value of all the tax leaks is thus given by

\[ 52.83 + 22.97 + 16.66 = 92.46 \]

Lease financing is more valuable than equity financing, notwithstanding the higher tax rate of the lessor, caused by the sufficient amount of favourable personal debt financing. Indeed, for an all equity financed investor we have for the taxes

\[ Tc_1 = Tc_2 = \tau (X-DP) = 0.35 \times 150 = 52.50 \]

and hence for the value of the taxes
\[ V [Tc] = 52.50/(1.06) + 52.50/(1.06)^2 = 96.25 > 92.46 \]

the last value being the total value of the taxes under Belgian leasing.

Analogously as before, we find that bank financing is more (less) valuable if the bank's tax rate is lower (higher) than that of the lessor.

For American leasing we have under the same assumptions as in the Belgian leasing case that \( L = 566.64 \). Taxable earnings are equal to those of table 3.1 For the equivalent loan bank financing we obtain (\( \tau_b = \tau_f \))

\[ r_b = 0.08811 \text{ and } B_0^D = 999.94 \]

and the net advantage of leasing is positive, due to the higher beneficial tax effect of the depreciation deductions to a more heavily taxed lessor, compared with the purchaser. The advantage would be larger for a faster depreciation scheme.

Notice that this advantage can only exist if the investing firm cannot directly borrow from personal bondholders. Direct personal borrowing will then be the tax minimizing choice, since by this financing method one avoids that part of the taxable earnings is distributed to the least favourable tax regime of the lessor. However, if the lessor can realize tax losses so that the corporate tax leak of the lessor can be negative, American leasing can still be valuable. To illustrate this fact let us look at one of the most quoted situations for the advantage of American leasing. Assume that \( \tau_B = \tau = 0 \), i.e. personal interest income is not taxed and the investor is in a non-tax paying position. It is clear that any transfer of income to a lessor with a strictly positive tax rate will cause a positive tax leak, while an all equity financed investor is not taxed at all. Only if a negative amount of taxable earnings is transferred to the lessor and if he can match these tax losses against other taxable income, resulting in negative incremental tax leaks, then there will be an advantage to American leasing. From appendix B equation (B5) we know that the value of the taxes of an American lessor (who can realize his tax losses) in the present situation is given by

\[ V [Tc'] = \frac{\tau_f}{(1- \tau_f)} (I - V[DP] - V[R']) \]
where $\tau_r$ is the lessor's tax rate, DP denotes the depreciation scheme and $R^f$ stands for the interest payments from the lessor to his bondholders. Without any tax deductible interest payments ($R^f = 0$) it is clear that the value of the taxes will always be positive since $V[DP] < 1$. The lessor must be sufficiently debt financed in order to be able to have a negative tax leak. Indeed, for the amount of debt we used mostly throughout the examples, i.e. $(B_0^f = 600, P_1^f = P_2^f = 300)$, it is not possible to get a negative tax leak. Actually, even if $DP_1 = 1000$ and $DP_2 = 0$, we have then

$$V[Tcr] = \frac{\tau_r}{1-\tau_r} (1000 - 1000/(1.06) - 36/(1.06) - 18/(1.06)^2)$$

$$= 6.62 \frac{\tau_r}{1-\tau_r}$$

Notice that since $\tau_B = 0$, we have that $r_B = r_0/(1-\tau_B) = r_0 = 0.06$. If $B_0^f = 900, P_1^f = P_2^f = 450$ and $DP_1 = 700, DP_2 = 300$, we find

$$V[Tcr] = \frac{\tau_r}{1-\tau_r} (1000 - 700/(1.06) - 300/(1.06)^2 - 54/(1.06)$$

$$- 27/(1.06)^2) = - 2.35 \frac{\tau_r}{1-\tau_r}$$

This shows that the asset must be written off rather quickly, and that the lessor has to take enough debt in order for American leasing to be advantageous in the present situation.

**Conclusion**

In this paper we studied the distribution of cash flows under various financing methods, in order to detect some tax reasons for financial leasing. We saw that any financing method causes a distribution of taxable earnings to different tax regimes, so that in order to minimize tax leaks (or equivalently maximize value) one has to choose a way of financing, directing earnings to the most favourable tax regimes. We found that apart
from some tax asymmetries between lessor and bank (lessor in a different
tax bracket, or a different debt position) Belgian leasing and bank finan-
cing are equivalent alternatives under our perfect market hypotheses.
Belgian leasing is preferable above bank financing if there is one of the
following tax asymmetries between lessor and bank:
- The lessor is in lower tax bracket than the bank.
- The lessor has the opportunity to take a larger amount of borrowing
  from lenders who are treated favourably by the tax authorities.

We also saw that this equivalence between leasing and bank financing
does not hold anymore for American leasing. Even if there are no tax
asymmetries between lessor and bank, differences in value can occur be-
cause of a different tax situation for lessor (bank) and lessee (purchaser).
If the lessor is more heavily taxed than the lessee, American leasing can
be advantageous, since in that case the lessor is able to obtain a larger tax
shield from the depreciation deductions. Finally, we showed that the
above advantage for American leasing will only occur for a non-tax
paying lessee, if negative taxable income is distributed to the lessor and if
the lessor has the possibility of matching tax losses against other income.

Appendix A

In this appendix we derive some formulae for Belgian leasing, which
will enable us to do all the necessary calculations for obtaining the distri-
bution of cash flows in a two period model. We start from equation (13)

\begin{equation}
V[L] = I + V[Tc^r] + V[Tp^r])
\end{equation}

expressing that the value to the lessor is zero if the value of the lease ren-
tals is equal to the investment outlay plus the value of the taxes paid by the
lessor and his security holders. We know that

\begin{equation}
T_p^r = \tau_B R^r
\end{equation}

\begin{equation}
T_c^r = \tau_r (R_L - R^r)
\end{equation}

where RL is the interest part of the lease rentals which can be determined
by equation (24). For a two period model one easily finds
\[(A4) \quad L = \frac{(1+i)^2}{2+i} I, \quad RL_1 = i.I, \quad DL_1 = L - RL_1 = \frac{I}{2+i} \]

\[DL_2 = I - DL_1 = \frac{1+i}{2+i} I, \quad RL_2 = i.DL_2 = \frac{i(1+i)}{2+i} I\]

We assume that tax losses can be realized so that taxes can be negative in equation (A3). One easily obtains from (A1), (A2) and (A3) that

\[(A5) \quad V[L] - \tau_r V[RL] - I = (\tau_B - \tau_r) V[R^r]\]

The left-hand side of equation (A5) is equal to

\[L_1/(1+r_0) + L_2/(1+r_0)^2 - \tau_r (RL_1/(1+r_0) + RL_2/(1+r_0)^2) - I\]

Using that RL_1 = i.I, RL_2 = i.DL_2, L_1 = RL_1 + DL_1 = i.I + I - DL_2 and L_2 = RL_2 + DL_2 = (1+i)DL_2, and working out the last expression leads to

\[\frac{I(1+r_0) + DL_2}{(1+r_0)^2} ((1-\tau_r) I - r_0)\]

so that

\[(A6) \quad (r_0 - (1-\tau_r) i) \frac{I(1+r_0) + DL_2}{(1+r_0)^2} = (\tau_r - \tau_B) V[R^r]\]

If the interest payments R^r are known (i.e. if the amount of personal debt is known) and if the tax rates are known, the implicit interest rate i can be obtained as the solution of equation (A6) which can be rewritten as a quadratic equation in i using (A4):

\[(A7) \quad a.i^2 + b.i + c = 0\]

with

\[a = (1-\tau_r)(2+r_0)\]

\[b = (1-\tau_r)(3+2r_0) - (2+r_0)r_0 + (\tau_r - \tau_B)(1+r_0)^2 \frac{V[R^r]}{I}\]

\[c = 2 (\tau_r - \tau_B)(1+r_0)^2 \frac{V[R^r]}{I} - (3+2r_0)r_0\]
Once i is known, taxable earnings can be computed by aid of the formulae (A4). Since

\[ V[RL] = \frac{i}{1+r_0} + i.DL_2/(1+r_0)^2 \]

we also have by equation (A6)

\[ (A8) \quad V[RL] = \frac{(\tau_r-\tau_B).i}{r_0 - (1-\tau_r).i} V[R^f] \]

It follows from (A3) and (A8) that we can write the value of the corporate taxes of the lessor as

\[ (A9) \quad V[Tcf] = \tau_r (V[RL] - V[R^f]) = \frac{((1-\tau_B).i - r_0)}{(r_0 - (1-\tau_r).i)} \tau_r V[R^f] \]

(A9) expresses the value of the corporate taxes of the lessor as a function of the value of the personal interest payments, the tax rates and the implicit interest rate i.

### Appendix B

In this appendix we derive some formulae for American leasing. Again we start from equation (13):


We know that

\[ (B2) \quad Tcf = \tau_r (L - DP - R^f) \quad \text{and} \quad Tp^f = \tau_B R^f \]

Assuming that tax losses can be realized, it follows that

\[ (B3) \quad V[Tcf] = \tau_r V[L] - \tau_r V[DP] - \tau_r V[R^f] \]

Combining (B1) and (B3) one gets

\[ (B4) \quad V[L] = \frac{1}{1-\tau_r} (I - \tau_r V[DP] - (\tau_r-\tau_B) V[R^f]) \]

For known tax rates, depreciation scheme and personal debt amount, it is now possible to calculate the value of the equilibrium lease rentals so that
the level lease rentals can also be derived. From (B4) and (B1) it results that

(B5) \[ V[Tc^r] = \frac{\tau_r}{1-\tau_r} (I - V[DP] - (1-\tau_B) V[R^r]) \]

Appendix C

We see in this appendix how the pie distribution caused by bank financing can be calculated using the equivalent loan principle. Our starting point now is equation (5):

(C1) \[ V[Tc^b] = V[Rp + Pp] - B_0^p - V[Tp^b] \]

We know that

(C2) \[ Tp^b = \tau_B R^b \]

(C3) \[ Tc^b = \tau_b (Rp - R^b) \]

It follows from (C1), (C2) and (C3) that

(C4) \[ V[Rp + Pp] - \tau_b V[Rp] - B_0^p = (\tau_B - \tau_b) V[R^b] \]

Completely analogous to the derivation of formula (A6) from formula (A5) we find

(C5) \[ (r_0 - (1-\tau_b)r_b) \frac{B_0^p (1+r_0) + P_2^p}{(1+r_0)^2} = (\tau_b - \tau_B) V[R^b] \]

where \( r_b \) is the cost of bank financing, i.e. the interest rate of the loan given by the bank to the purchaser.

Since

\[ V[Rp] = R_1^p/(1+r_0) + R_2^p/(1+r_0)^2 \]
we have by equation (C5), noticing that \( R_1^P = r_b B_0^P \) and \( R_2^P = r_b P_2^P \)

\[
V[R_P] = \frac{(\tau_b - \tau_B) r_b}{r_0 - (1 - \tau_b) r_b} V[R_b]
\]

Hence, it follows from (C3) that we can write the value of the corporate taxes of the bank as

(C6) \[ V[Tc^b] = \tau_b V[R_P] - V[R_b] = \frac{((1 - \tau_B) r_b - r_0)}{(r_0 - (1 - \tau_b) r_b)} \tau_b V[R_b] \]

In order to solve the cost of bank financing \( r_b \) from equation (C5), it is necessary however to know something about the loan amount \( B_0^P \) and the repayment schedule \( P^P \). As explained before in the text, we will use the equivalent loan principle in the comparison of bank financing with leasing, i.e. equation (26)

\[ F_P + Tc_P = L + Tc_e \]

or

(C7) \[ (1 - \tau) R_P + P_P = L + Tc_e - \tau(X - DP) \]

(under the assumption that tax losses can be realized).

Call the right-hand side of equation (C7) (which is equal to \( L - \tau.RL \) for Belgian leasing, and equal to \((1 - \tau)L + \tau.DP \) for American leasing)

\[ A = (A_1, A_2) \]. It then follows, that

(C8) \[ B_0^P = \sum_{t=1}^{2} \frac{A_t}{(1 + (1 - \tau) r_b)^t}, \quad P_2^P = \frac{A_2}{1 + (1 - \tau) r_b} \]

\( r_b \) can now be obtained as solution of a quadratic equation which results from filling in (C8) in equation (C5) :

(C9) \[ a.r_b^2 + b.r_b + c = 0 \]

with

\[ 12 \] See for example DURINCK and FABRY (1983).
\[a = (1-\tau) (1-\tau_b)(A_1(1+r_0) + A_2) + (1-\tau)^2 (1+r_0)^2 (\tau_b - \tau_B)V[R^b]\]

\[b = (1-\tau_b)(A_1(1+r_0) + A_2(2+r_0)) - (1-\tau) r_0(A_1(1+r_0) + A_2)\]

\[+ 2(1-\tau)(1+r_0)^2 (\tau_b-\tau_B)V[R^b]\]

\[c = (1+r_0)^2 (\tau_b - \tau_B)V[R^b] - r_0(A_1(1+r_0) + A_2(2+r_0))\]

Once \(r_b\) is known, the loan amount \(B_0^\delta\) and its repayment schedule are given by (C8), and all taxable earnings and taxes can be calculated.
GLOSSARY OF USED SYMBOLS

\( r_0 \) = required return on tax free income  
\( r_B \) = interest rate on personal debt income  
\( r_b \) = interest rate on a bank loan  
\( i \) = implicit interest rate of the lease  
\( \tau \) = corporate tax rate of the purchaser or lessee  
\( \tau_b \) = corporate tax rate of the bank  
\( \tau_r \) = corporate tax rate of the lessor  
\( \tau_B \) = personal tax rate on bond income  

In what follows * can take different values:

if * = p then firm * = the purchaser  
= b = the bank  
= e = the lessee  
= r = the lessor

\( B_0^* \) = nominal loan amount borrowed by firm * at time zero  
\( I \) = investment outlay  
\( t \) = time period  
\( V[.] \) = value of the cash flow or variable between the brackets  
\( V^* \) = value of the project to firm *

Other capitals denote multiperiod cash flows or variables. A subscript refers to the time period. If no subscript is used, the whole cash flow is meant (e.g. \( X = (X_1, \ldots, X_n) \)).

\( X \) = operating cash flow  
\( DP \) = depreciation deduction  
\( D^* \) = payments by firm * to its equityholders  
\( R^* \) = interest payments by firm * to its creditors  
\( P^* \) = principal payments by firm * to its creditors  
\( F^* \) = total payments by firm * to its creditors, after personal taxes if these creditors are personal debtholders

\( L \) = lease payments by the lessee to the lessor  
\( DL \) = principal part of the lease payments  
\( RL \) = interest part of the lease payments  
\( E^* \) = taxable earnings of firm*  
\( E_B^* \) = taxable earnings of the personal bondholders  
\( Tc^* \) = corporate taxes paid by firm *  
\( Tp^* \) = personal taxes paid by the bondholders of firm *

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13 Notice that we assume that the purchaser borrows from a bank while lessor or bank borrow from individual investors.
References


