Theory of Financial Lease Contracts

Why all capital goods are not leased

Jussi Penttinen

University of Helsinki
Faculty of Social Sciences
Department of Political and Economic Studies
The economic theory states that the capital structure of a firm is irrelevant in a perfect frictionless world. Hence when the assumptions of the Modigliani–Miller theorem and the CAPM hold, the question about the optimal source of funding of capital investments is also irrelevant. In practice though, capital leasing is widely used and the decision to lease or own assets is hardly a matter of indifference to firms or individuals. The motivation of this thesis is to identify when and why leasing would be a preferred method of finance.

The Modigliani–Miller indifference proposition assumes rational value maximizing agents that have perfect and symmetric information available, and have access to perfect capital markets when making decisions on investments to divisible assets under a neutral tax system. In reality though the future cash-flows from capital investments are almost always uncertain at the time of an investment decision, the access to risk free borrowing is limited and the size of capital investments have technical limitations. The indifference proposition, however, holds even if the future cash flows are uncertain as long as the assumptions of the CAPM are valid. Instead the asymmetry of information is a critical violation of assumptions for the indifference proposition. First asymmetry on information on management performance may induce risk averse management to prefer relatively safe leasing instead of owning equipment when there is uncertainty on the future value of the asset. On the other hand the information asymmetry on the usage of the asset may cause an agent–principal problem between the lessor and the lessee increasing the cost of leasing. This in turn may cause an adverse selection problem where only users who cause greater wear and tear on the asset utilize leasing. The indifference proposition also ceases to apply when investments can be made only in fixed quantities and access to risk-free borrowing is limited. A risk-averse investor cannot then diversify the asset specific risk related to owning the asset through the market. Leasing, however, provides a way to de-risk a capital investment since the risk in the residual value of the leased asset is carried by the lessor.

Limited access to risk-free credit causes also another problem that creates demand for leasing. Normally 100% debt finance is not possible since repossession of collateralized assets is costly. Therefore lenders require part of the investment to be made with internal funds so that in case of a default the creditor can recover both the loan principal and the repossession costs. Meanwhile in case of leasing the lessor retains the title to the asset and there is no deadweight cost of repossession. For agents with limited internal funds leasing can then offer a way to expand capacity faster than would be possible when financing the investment with internal and borrowed funds.

The impact of taxation on the validity of the Modigliani–Miller theorem has been actively researched and widely documented in the context of determining the optimal mix of debt and equity in the capital structure of a firm. Not surprisingly taxation also distorts the indifference proposition in case of lease or buy decision. When there are differences in the marginal tax rates between firms, there exists an opportunity for tax arbitrage when lessee companies with lower marginal tax rates lease assets from lessor companies with higher marginal tax rates.

Avainsanat – Nyckelord – Keywords
Capital structure, leasing, lease or buy, collateral requirements
# Contents

1 Introduction

2 Description of Financial Lease Contracts

3 The Neoclassical Analysis
   3.1 Lessor’s analysis
   3.2 Lessee’s analysis
   3.3 Valuing long term leases

4 Neoclassical analysis extended for uncertainty
   4.1 Lessor’s analysis
   4.2 Lessee’s analysis

5 Risk attitudes and expectations about the future

6 Tax Incentives
   6.1 Lessee’s analysis
   6.2 Lessor’s analysis
   6.3 Net gain to leasing
   6.4 Model limitations

7 Imperfect Capital Markets
   7.1 Collateral requirements
   7.2 Separation of ownership and control
   7.3 Assumptions
   7.4 Lessor’s problem
   7.5 Lessee’s problem
   7.6 Equilibrium

8 Conclusions
Bibliography
1 Introduction

One of the cornerstones of modern corporate finance is the Modigliani–Miller theorem. The key result of the theorem is a proposition that the capital structure of a firm is irrelevant in perfect frictionless world. Modigliani (1980, p. xii) explains the theorem as follows:

... with well-functioning markets (and neutral taxes) and rational investors, who can ‘undo’ the corporate financial structure by holding positive or negative amounts of debt, the market value of the firm – debt plus equity – depends only on the income stream generated by its assets. It follows, in particular, that the value of the firm should not be affected by the share of debt in its financial structure or by what will be done with the returns – paid out as dividends or reinvested (profitably).

The underlying assumptions behind the Modigliani–Miller theorem are (i) tax neutrality (ii) no transaction costs (iii) symmetric information (iv) complete contracting and (v) complete markets. (see e.g. Graham, 2003, Villamil, 2008).

The Modigliani–Miller theorem also forms the foundation of the theory on leasing finance. In a neoclassical view the rental terms offered by a lessor have to reflect the underlying cost of owning the asset subject to the lease contract, that is interest and depreciation. For a lessee the choice between leasing or buying an asset would then depend only on the relative cost of these options. In a perfectly competitive market for lease contracts with no taxes and where everyone is facing the same interest rates, the quoted lease rates would adjust until the financial costs of leasing and buying were equal. Hence firms should be indifferent on whether to lease or buy assets. In practice though whether to lease or buy is usually not a matter of indifference to firms (Miller and Upton, 1976, p. 762) and both leasing and debt/equity financing are coexisting.

In addition to financial costs, acquiring the services of capital goods involve non-financial costs of procurement, maintenance, repair and disposal. Separating the
ownership and use of the capital goods can create opportunities for specialization
and greater efficiency in these separate roles. In some cases pursuing these efficiencies
can become the decisive factor for a company considering between leasing and owning
an asset. This thesis focuses, however, on pure financial lease contracts where the
lessor’s role is solely that of a financier.

The objective of this thesis is to identify factors that determine the value of financial
lease contracts. The question to be answered is why and under which conditions
companies as well as individuals should utilize leasing rather than debt or equity to
finance their capital investment projects.

The structure of this thesis is as follows: Chapter 2 provides first a general descrip-
tion of leasing and financial lease contracts. Chapters 3 and 4 lay the foundation
of the analysis by studying leasing within the neoclassical framework. Chapter 5
then substitutes the neoclassical value maximizing firm with a more generic utility
maximizing agent. The key point of interest in Chapter 5 is how risk aversion and
differences in expectations influence the lease or buy decision.

The impact of taxes on the Modigliani–Miller theorem is one of the most studied
areas in corporate finance and Chapter 6 continues on this tradition by showing how
leasing can be used as vehicle for tax arbitrage. Chapter 7 then relaxes assumptions
about symmetric information and complete markets. Chapter 7 presents how limited
access to borrowed funds combined with an agent–principal problem can lead to a
situation where leasing is a preferred by agents with limited internal funds, because
it offers a way to expand capacity faster than would be possible when financing the
investment with external funds.
2 Description of Financial Lease Contracts

Creation of financial lease contracts and related transactions are depicted in Figure 2.1 on page 3 (Tepora, 1988, pp. 249-257):

1. The seller and the customer (lessee) negotiate about the object of the contract.

2. The seller makes an offer to the lessor concerning buying the object to be leased to the named customer. The offer includes approval of the offer from the customer.

3. When the lessor approves the offer, a sales contract between the lessor and the seller, and a leasing contract between the lessor and the lessee is made. The sales contract can also include provisions about the seller buying the object back at the end of the lease period. Likewise the lease contract can contain provisions about the lessee having an option to buy the object at the end of the lease period.

4. The lessor orders the object to be delivered to the lessee.

Figure 2.1: Leasing parties and transactions.

1. The seller and the customer (lessee) negotiate about the object of the contract.

2. The seller makes an offer to the lessor concerning buying the object to be leased to the named customer. The offer includes approval of the offer from the customer.

3. When the lessor approves the offer, a sales contract between the lessor and the seller, and a leasing contract between the lessor and the lessee is made. The sales contract can also include provisions about the seller buying the object back at the end of the lease period. Likewise the lease contract can contain provisions about the lessee having an option to buy the object at the end of the lease period.

4. The lessor orders the object to be delivered to the lessee.
5. The seller delivers the object to the lessee and sends the invoice to the lessor.

6. Typically the lessee pays the first lease payment when the invoice is due and the subsequent payments are due at the beginning of each lease period.

7. At the end of the lease contract the lessee returns the depreciated object to the lessor. If the sales contract between the lessor and the seller included a provision for buyback, it is exercised and the object is returned to the seller. Alternatively if the lease contract has an option for extending the lease period or acquire the depreciated object, the lessee can exercise these options.

A characteristic feature of leasing is separation of ownership and control of the leased asset with the lessee receiving the benefits of use and the lessor receiving the value of the lease payments plus the residual value of the asset (Grenadier, 1995). In practice this separation is not, however, discrete, but there is a continuum of different types of lease contracts where the degree of control over the asset between the lessor and the lessee varies. In financial lease contracts, that this thesis is focusing at, the lessor has the ownership of the asset while the lessee has full control over it.
3 The Neoclassical Analysis

A neoclassical model provides a natural starting point for analyzing leasing markets. To begin with, we assume the following technological, financial and market conditions (Miller and Upton, 1976, pp. 763-764):

1. The capital leased are produced by perfectly competitive industry at a constant cost of $c_t$ per unit of capital $k$ at time $t$. The same capital will be produced by the industry again at time $t + 1$ at cost $c_{t+1}$, that can be higher or lower than $c_t$.

2. The capital deteriorates over time and a unit of capital produced at time $t$ can produce the same service flow in period $t + 1$ as $(1 - \delta_t)$ new units. The rate of deterioration is endogenous and independent of whether the user of the capital owns or leases it.

3. Used capital can be bought, sold and sublet in any quantities in perfect, competitive markets.

4. There is a perfect financial market where companies can borrow and lend in unlimited quantities at a known one-period interest rate $r_t$. Furthermore there are no entry barriers to leasing business and both producers and users of capital can have their own leasing subsidiaries.

5. The cost of capital goods $c_t$, rate of deterioration $\delta_t$ and interest rate $r_t$ are known for certainty for all $t$.

3.1 Lessor’s analysis

Since the capital is produced by a perfectly competitive industry, the producers earn zero profits and the price of the capital must equal the production cost. Moreover as the production cost is constant, the demand for capital has no impact on the unit price of the capital but only on the quantity employed.
The present value of a one period lease contract for a lessor at time $t$ is then

$$V_c = \left( l_t - c_t + \frac{(1 - \delta_t) c_{t+1}}{1 + r_t} \right) k_l$$

(3.1)

where $l_t$ is period $t$ lease rate per unit of leased capital $k_l$ produced at the beginning of period $t$. That is, the lessor incurs a cost of $c_t k_l$ to obtain the title to capital $k_l$, receives the lease payment $l_t k_l$ at the beginning of period $t$, and gets the salvage value of the depreciated capital $(1 - \delta_t) c_{t+1} k_l$ at time $t+1$. Notice, that since the rate of deterioration $\delta_t$ and cost of capital $c_t$ are known for certain, the cash flow at time $t+1$ can be discounted using the risk free interest rate $r_t$.

The leasing market was assumed perfectly competitive and hence all the lessors make zero profit, $V_c = 0$. Using (3.1), we get the equilibrium one-period lease rate

$$l_t^* = \frac{r_t c_t + \delta_t c_{t+1} + c_t - c_{t+1}}{1 + r_t}$$

(3.2)

where $r_t c_t$ is the opportunity cost of capital, i.e. interest forgone on the capital invested, $\delta_t c_{t+1}$ is the cost of asset deterioration and $c_t - c_{t+1}$ is the obsolescence cost of one period old capital at time $t+1$.

If the ongoing rental rate were to increase above the equilibrium level, $l_t > l_t^*$, higher than normal returns would attract new entrants buying capital at the constant price $c_t$ and cutting the prevailing rental rate until it reaches it’s equilibrium level $l_t^*$. If, on the other hand, the ongoing rental rate would fall below the equilibrium level, $l_t < l_t^*$, the owners of the capital would be strictly better off by selling their capital at the constant price $c_t$ and invest the proceeds of the sale in capital markets to earn interest $r_t c_t k_l$. The lessors would be then exiting from the market until the lease rate reached the equilibrium level $l_t^*$.

### 3.2 Lessee’s analysis

Employing capital $k$ the lessee gets service flow $f(k)$, that is assumed increasing in $k$, $\frac{\partial f(k)}{\partial k} > 0$. $f(k)$ can be thought as a production function where the lessee’s value is derived from selling the goods produced. $f(k)$ can also represent e.g. the
3.2 Lessee’s analysis

intrinsic value of housing services obtained by renting an apartment. The capital, \( k \), can either be bought or leased with both types of capital being perfect substitutes. That is \( k = k_b + k_l \), where \( k_b \) is bought, owned capital and \( k_l \) is leased capital. The present value of the lessee’s value from employing capital \( k \) is then

\[
V_d = \frac{f(k) + (1 - \delta_t)c_{t+1}k_b}{1 + r_t} - l_t k_l - c_t k_b
\]

(3.3)

where the first term is the present value of the cash flow at time \( t+1 \), that is the sum of the service flow from the capital and the salvage value of the purchased capital. The second term is the lease payment made at time \( t \) and the last term is the cost of the purchased capital. Using (3.2) gives the lessee’s value at the equilibrium

\[
V_d^* = \frac{f(k) + (1 - \delta_t)c_{t+1}(k_b + k_l)}{1 + r_t} - c_t(k_b + k_l)
\]

\[
= \frac{f(k) + (1 - \delta_t)c_{t+1}k}{1 + r_t} - c_t k
\]

and hence the value derived by the lessee depends only on the total amount of capital employed and is independent of the financing decision.

This result has an intuitive explanation recognizing that a common abstraction made in economics is to consider having the title to the capital and using it as two separate economic activities. Therefore, we can without loss of generality, consider a company that owns the capital goods it employs equal to a lessee company having it’s own leasing subsidiary. The lease rate the in-house leasing subsidiary should charge is the market equilibrium lease rate, since any other lease rate in internal transfer pricing would result in inefficient use of capital. Obviously for purely financial reasons the user of the capital goods is then indifferent whether to lease the capital from an outside lessor company or from the in-house leasing subsidiary as the lease rate is same in both cases. On the other hand, we concluded in the previous section that in a perfectly competitive leasing market, lessors always earn zero profits. Hence there is no purely economical reason for a user of capital goods to buy into the leasing business, and consequently the firms should be indifferent between buying and leasing capital. (Miller and Upton, 1976, p. 764)
3.3 Valuing long term leases

In reality lease contracts are often long term leases extending over multiple periods. In neoclassical world the conclusions are, however, still fundamentally the same as in case of one period lease contracts analyzed in the previous sections. In the absence of transaction and search costs, the equilibrium value of an \( n \)-period lease must be equal to \( n \) equilibrium one-period leases. If the equilibrium value of an \( n \)-period long term lease was lower than the sum of \( n \) one-period rentals, lessors would be better off by offering only one-period leases and the long-term lease rates would increase until they would offer the same return as the one-period leases. If, on the other hand, the value of a equilibrium \( n \)-period long term lease was higher than the value of \( n \) short term leases, lessors would be strictly better off by making \( n \) one period rentals instead of one \( n \)-period long term lease. The lessors would continue to move from long term lease to short term leases until the value of the leases were equal.

In order to determine the equilibrium value of an \( n \)-period lease, consider first the equilibrium lease rate at period \( t + 1 \). At time \( t + 1 \) the lessee can either lease new capital or one period old capital providing the same service flow as \((1 - \delta_t)\) new units. Obviously the equilibrium rental rate of one period old capital has to be then \((1 - \delta_t)l_{t+1}^*\). If the rental rate of old capital was higher than the rental rate of new capital adjusted for the asset deterioration, all the lessees would rent only new capital that under our assumptions is offered in any quantities at constant rental rate \( l_{t+1}^* \). On the other hand, if the rental rate of old capital were to fall below \((1 - \delta_t)l_{t+1}^*\), the lessor’s owning old capital would get a better return by selling old deteriorated capital than by renting it. Using (3.2), and assuming that the depreciation rate and market rate of interest are constant over time, i.e. \( r_t = r \) and \( \delta_t = \delta \), we get the present value of an \( n \)-period long term lease contract:

\[
V(n) = \sum_{t=1}^{n} \frac{t^r(1 - \delta)^{t-1}k_l}{(1 + r)^{t-1}} + c_n \left( \frac{1 - \delta}{1 + r} \right)^n k_l - c_1 k_l
\]

where \( L(n) = \sum_{t=1}^{n} \frac{t^r(1 - \delta)^{t-1}k_l}{(1 + r)^{t-1}} \) is the present value of the \( n \) one-period equilibrium lease payments, \( c_n \left( \frac{1 - \delta}{1 + r} \right)^n k_l \) is the salvage value of the used \( n \) periods old capital and the \( c_1 k_l \) is the purchase price of the leased capital at the beginning of the lease contract.
3.3 Valuing long term leases

In long term leases it is often a practice to set the periodical rental rates constant over the duration of the lease contract. In the neoclassical world the agents are indifferent between any cash flows that have the same present value and hence:

\[ L(n) = \sum_{t=1}^{n} \frac{l^* k_t}{(1 + r)^{t-1}} = \frac{1 + r - (1 + r)^{1-n}}{r} l^* k_1 \]  

(3.4)

where \( l^* \) is the uniform equilibrium rental rate for \( n \)-period rental and the second equality follows directly from the properties of geometrical series. Solving (3.4) for \( l^* \) gives the uniform equilibrium rental rate:

\[ l^* = \frac{r(1 + r)^{n-1} L(n)}{(1 + r)^n - 1} k_l \]

where \( \frac{r(1+r)^{n-1}}{(1+r)^n - 1} \) is the capital recovery factor. (Miller and Upton, 1976, p. 765)

If the lease covers the economical life the asset so that the salvage value of the leased capital at the end of the lease contract is zero, \( c_n \left( \frac{1-d}{1+r} \right)^n k_l = 0 \) and the leasing market is perfectly competitive, \( V(n) = 0 \), then the uniform equilibrium rental rate becomes:

\[ l^* = \frac{r(1 + r)^{n-1} c_1}{(1 + r)^n - 1} \]

(3.5)

This is also the formula for an \( n \)-period annuity, which is logical considering that when the length of a lease contract equals the economical life of the asset, an \( n \)-period lease contract with uniform rental rate is essentially equal to financing the purchase of the asset with an annuity loan. In practice, leasing an asset is often more efficient than owning it if the expected economical life of the asset is greater than the expected need for it, since selling an asset is costly (Smith C., Wakeman L., 1985).
4 Neoclassical analysis extended for uncertainty

For durable goods there are risks involved with the market value of the asset since in reality, the cost of following period capital goods, $c_{t+1}$, and depreciation rate, $\delta_t$, are rarely known in advance. In the following two chapters we study the impact of relaxing simplifying assumption 5 on page 5 and allow for uncertainty in the future cost of capital goods and depreciation rate. Here we assume that the lease payment is made at the beginning of the lease period and thus the lease rate $l_t$ is known in advance. The valuation framework used is the Sharpe–Lintner capital asset pricing model (later CAPM), which implies the following assumptions (Jensen, 1979, pp. 23-24):

1. All investors choose portfolios on the basis of their single period mean and variance of return.
2. All investors can borrow or lend at a given riskless rate of interest and there are no restrictions on short sales of any asset.
3. All investors have identical subjective estimates of the joint probability distribution on the returns of all assets.
4. All assets are perfectly liquid and divisible.
5. There are no taxes.
6. The quantities of all assets are given and all investors are price takers.

Under the assumptions of the CAPM, the expected equilibrium rate of return on any asset is (see e.g. Jensen, 1979, p. 24, Jagannathan and McGrattan, 1995, p. 3):

$$E(r) = r_f + \beta [E(r_m) - r_f]$$  \hspace{1cm} (4.1)
Chapter 4 Neoclassical analysis extended for uncertainty

where \( r_f \) is the risk free rate of return, \( E(r_m) \) is the expected rate of return on the total wealth and \( \beta = \text{Cov}(r, r_m)/\text{Var}(r_m) \) is a measure of the relative, nondiversifiable risk of the asset in question.

### 4.1 Lessor’s analysis

From the view point of a leasing company the leased asset is like any other asset and it has return:

\[
r_l = \frac{(1 - \delta_t) c_t}{c_t - l_t} - 1
\]

(4.2)

where \( \delta_t = 1 - (1 - \delta_t) \frac{c_t}{c_{t+1}} \) is the economic depreciation of the asset, \((1 - \delta_t) c_t \) is the uncertain cash flow from selling a unit of the depreciated capital asset in the future at time \( t+1 \), and \( c_t - l_t \) is the (certain) net cash flow at time \( t \) after making the payment for the capital and collecting the lease payment. Notice that all the uncertainty in \( r_l \) is now due to \( \delta_t \) that captures both asset deterioration and obsolescence effects.

Using (4.2) we can calculate the expected equilibrium return on the leased asset, \( E(r_l) = \frac{(1-E(\delta_t)) c_t}{c_t - l_t} - 1 \), and the covariance between the return on the leased asset and the return on the market portfolio, \( \text{Cov}(r_l, r_m) = \frac{-\text{Cov}(\delta_t, r_m) c_t}{c_t - l_t} \). Using these results (4.1) can now be written as:

\[
\frac{(1 - E(\delta_t)) c_t}{c_t - l_t} - 1 = r_f - \frac{\text{Cov}(\delta_t, r_m) c_t}{(c_t - l_t) \text{Var}(r_m)} [E(r_m) - r_f]
\]

(4.3)

Solving (4.3) for the lease rate, \( l_t \), gives the equilibrium lease rate:

\[
l_t^* = \left( \frac{r_f + E(\delta_t) - a_m \text{Cov}(\delta_t, r_m)}{1 + r_f} \right) c_t
\]

(4.4)

where \( a_m = \frac{E(r_m) - r_L}{\text{Var}(r_m)} \) is the market price of risk and (4.4) is the certainty equivalent pricing formula for the rental rate. If the lease rate was lower than the equilibrium rate, the investors could earn higher expected return by investing their funds into the
market and would be exiting the leasing business. On the other hand, a return higher than the equilibrium return would attract new entrants into leasing until the lease rate was bid down to the equilibrium level. Notice that if the economic depreciation of the asset is completely uncorrelated with the market return, \( \text{Cov}(\tilde{\delta}_t, r_m) = 0 \), then the one period lease rate simply becomes \( l_t^* = \frac{r_f + E(\tilde{\delta}_t) c_t}{1 + r_f} \). In other words, the one period equilibrium lease rate is the present value of the opportunity cost of capital and expected depreciation.

If the rate of depreciation was positively correlated with the market return, \( \text{Cov}(\tilde{\delta}_t, r_m) > 0 \), it would result in a lower equilibrium rental rate. This could happen e.g. if higher economical activity would encourage more innovation increasing the speed at which technology becomes obsolete, or if a lower level of economical activity was to decrease the utilization of the leased assets lowering the wear and tear, and consequently the rate of deterioration. A positively correlated rate of depreciation would then make the lessors willing to accept lower rate of rental because offering leases could lower their overall risk exposure. On the other hand, if harder economical times were to result in faster technological progress due to more fierce competition increasing the likelihood of obsolescence, or if diminished returns would make lessees neglect maintenance of equipment so that \( \text{Cov}(\tilde{\delta}_t, r_m) < 0 \), the lessor’s would require higher lease rate’s to compensate for the increased systematic risk.

### 4.2 Lessee’s analysis

In a world adhering to the assumptions of the CAPM the value of a firm is the present value of its cash flow (Hite, 1979, p. 165), that is

\[
V_d = \frac{f(k) + (1 - E(\tilde{\delta}_t) + a_m \text{Cov}(\tilde{\delta}_t, r_m)) k_b}{1 + r_f} - (l_t k_l + k_b),
\]

The return on the lessee’s uncertain cash flow at the end of period is \( \frac{f(k) + (1 - E(\tilde{\delta}_t)) k_b}{V_d} \), where \( V_d \) is the present value of the end of period cash flow. Using the CAPM (4.1) gives \( \frac{f(k) + (1 - E(\tilde{\delta}_t)) k_b}{V_d} = r_f - \frac{k_b \text{Cov}(\tilde{\delta}_t, r_m)}{\text{Var}(r_m)} [E(r_m) - r_f] \). Solving the equation for \( V_d \) gives us the risk adjusted present value for the end of period cash flow, \( V_d = \frac{f(k) + (1 - E(\tilde{\delta}_t) + a_m \text{Cov}(\tilde{\delta}, r_m)) k_b}{1 + r_f} \), where \( a_m = \frac{E(r_m) - r_f}{\text{Var}(r_m)} \) is the market price for risk.

1
where $f(k)$ is the present value of the service flow from capital $k$, \( \frac{(1-E(\tilde{\delta}_t)+a_mCov(\tilde{\delta}_t,r_m))k_b}{1+r_f} \) is the risk adjusted present value of the depreciated capital, and \( l_t'k_l + k_b \) is the total payment made at the beginning of the period for the capital leased and bought.

The lessee will then select the amount of capital to lease and to buy so that the value of the firm is maximized while the lessors charge the equilibrium lease rate $l_t'$. When the lease rate is at equilibrium, the lessee’s value becomes

$$V_{d^*} = f(k) + \left( 1 - E(\tilde{\delta}_t) + a_mCov(\tilde{\delta}_t,r_m) \right) \frac{(k_l + k_b)}{1+r_f} - (k_l + k_b)$$

$$= f(k) + \left( 1 - E(\tilde{\delta}_t) + a_mCov(\tilde{\delta}_t,r_m) \right) k \frac{1}{1+r_f} - k$$

Hence the lessee’s value depends again only on the total amount of capital employed and including uncertainty on the future cost of capital, $c_{t+1}$, and the rate at which the capital deteriorates, $\delta_t$, does not impact the conclusions about the irrelevance of the financing decision under the assumptions of the CAPM.

Miller and Upton (1976, pp. 767 - 772) reach a similar conclusion also using the Sharpe–Lintner CAPM model, but with a somewhat different approach. Smith (1979, pp. 104-106) employs the Black–Scholes option pricing framework to characterize leasing. Smith’s analysis is based on the observation that a collateralized loan contract is equivalent to selling the collateralized asset to the lender for a bundle containing the proceeds from the loan, a lease giving the control to the asset and a call option to repurchase the asset with a strike price equal to the loan repayment and accrued interest at the end of the period. That is

$$V = D + L + C$$

(4.5)

where $V$ is the value of the collateral, $D$ is the proceeds from the loan, i.e. the funds the debtor receives at the beginning of the loan period by promising to repay amount $X$ at the end of the loan period, $L$ is is the value of the lease and $C$ is the value of the call to repurchase the asset at price $X$ at the end of the loan period. Assuming that there are no costs, fees or penalties for the repossession of the collateral, the expected value of the repayment of the loan at the end of the loan
4.2 Lessee’s analysis

period is \( \int_0^X V_T g(V_T) dV_T + \int_X^\infty X g(V_T) dV_T \), where \( V_T \) is the value of the depreciated capital at the end of the loan period at time \( T \) and \( g(V_T) \) is the probability density function of the value of the depreciated capital at the end of the loan period at time \( T \). Hence the funds a risk neutral creditor would be willing to lend against the collateralized loan contract at the beginning of the loan period

\[
D = e^{-rT} \left( \int_0^X V_T g(V_T) dV_T + \int_X^\infty X g(V_T) dV_T \right)
\]  
(4.6)

where \( r \) is the risk free interest rate. The value of a call option with strike \( X \) at the terminal date \( T \) of the contract is the maximum of either the difference of the underlying asset and the exercise price, \( V_T - X \), or zero and for a risk neutral investor the value of the call at the beginning of the contract period is

\[
C = e^{-rT} \int_X^\infty (V_T - X) g(V_T) dV_T
\]  
(4.7)

Solving (4.5) for \( L \) and using (4.6) and (4.7) gives

\[
L = V - e^{-rT} \left( \int_0^X V_T g(V_T) dV_T + \int_X^\infty X g(V_T) dV_T \right) - e^{-rT} \int_X^\infty (V_T - X) g(V_T) dV_T
\]  
(4.8)

Thus the value of a lease for the lessee equals the value of the asset minus a claim on the value of the asset after time \( T \), that is also the cost of owning the asset. Therefore \( L \) is also the maximum price a lessee would be willing to pay for the lease contract. If the price of the lease was higher than \( L \), the lessee would always be better off buying the asset.

From the lessor’s point of view, all the cash flows of a lease contract are equal, but of opposite sign and therefore (4.8) also holds for the lessor. For the lessor, \( L \) is the minimum price at which he would be willing to offer the lease contract, because otherwise the lease payment would not cover the expected change in the asset value. Since \( L \) is the maximum price a rational lessee would be willing to pay for a lease and also the minimum price at which a rational lessor would be offering a lease,
(4.8) also gives the equilibrium lease payment and hence in equilibrium the lessee is indifferent between leasing and owning the asset.

By now, this result is hardly surprising and just confirms the conclusion reached earlier using the Sharpe–Lintner CAPM framework. The option pricing framework can be also used to value more complex lease contracts with options to e.g. extend the lease or buy the object at the end of the contract as in Grenadier (1995) and Bellalah (2002).

Assuming that the asset value at time $T$, $V_T$, follows log-normal distribution value of the lease becomes

$$L = V \left(1 - e^{-(r+\delta)T}\right)$$

where $\delta$ is the average expected rate of decrease in asset value, $E \left(V_T/V\right) = e^{-\delta T}$.

From (4.9) it is easy to see that the greater the risk free interest rate, $r$, and the expected rate of depreciation, $\delta$, the higher the equilibrium price of a lease is. This is obvious as the higher the interest rate, the higher the lease payments needed to compensate for the increased opportunity cost of investing into capital are. On the other hand the higher the expected rate of depreciation the smaller the expected value of the asset at time $T$ is and the higher the lease payment needed to compensate for the loss of the value of the asset are.

---

2 If $g(x)$ is log normal density function with

$$z = \begin{cases} 
0, & \text{if } x > \phi y \\
\lambda x - \gamma y, & \text{if } \phi y \geq x \geq \psi y \\
0, & \text{if } x < \psi y
\end{cases}$$

Then

$$E(z) = \int_{\phi y}^{\psi y} (\lambda x - \gamma y) g(x) dx$$

$$= e^{\rho T} \lambda x_0 \left[ N \left\{ \frac{\ln(x_0/\phi y) + (\rho + \sigma^2/2)T}{\sigma \sqrt{T}} \right\} - N \left\{ \frac{\ln(x_0/\phi y) + (\rho + \sigma^2/2)T}{\sigma \sqrt{T}} \right\} \right]$$

$$- \gamma y \left[ N \left\{ \frac{\ln(x_0/\psi y) + (\rho - \sigma^2/2)T}{\sigma \sqrt{T}} \right\} - N \left\{ \frac{\ln(x_0/\psi y) + (\rho - \sigma^2/2)T}{\sigma \sqrt{T}} \right\} \right]$$

where $\psi$, $\phi$, $\lambda$ and $\gamma$ are arbitrary parameters and $\rho$ is the average expected rate of growth in $x$ ($E(x/x_0) = e^{\rho T}$) and $N \left\{ \cdot \right\}$ is the cumulative standard normal function. (Smith and Wakeman, 1985, p. 83)

The result follows by applying the solution with $\psi = 0$, $\phi = \infty$, $\lambda = e^{-rT}$, $\gamma = 0$ and $\rho = -\delta$. 

---
5 Risk attitudes and expectations about the future

As presented in the previous chapter, in frictionless markets a value maximizing firm is indifferent between leasing and buying its capital as predicted by the Modigliani–Miller theorem. The assumptions under which the CAPM applies are, however, rather restrictive and in the following section we analyze leasing under more general expected utility maximizing framework. The analysis presented is closely related to the optimal contracting analysis of Wolfson (1985) and Leland (1978) and is based on the frameworks presented by Brick and Jagpal (1984) in the context of quality decision under uncertainty and Leland (1980) in the context of optimal portfolio insurance.

Let us assume that the leasing market behaves as if it was composed of representative or “average” lessors whose expected utility of future profits is:

\[ W_c = E_c \left\{ U_c \left[ (l_t - c_t + \frac{(1 - \delta_t) c_t}{1 + r_t}) k_t \right] \right\} \]  

(5.1)

where \( U_c \) denotes lessor’s utility and \( P_c = \left( l_t - c_t + \frac{(1 - \delta_t) c_t}{1 + r_t} \right) k_t \) is the present value of lessor’s profit. The leasing market is still assumed perfectly competitive and in equilibrium the lessors are not expected to make any profit:

\[ W^*_c = E_c \left\{ U_c \left[ \left( l^*_t - c_t + \frac{(1 - \delta_t) c_t}{1 + r_t} \right) k_t \right] \right\} \]

= \( U_c(0) \)

where \( U_c(0) \) denotes to the lessor’s utility when he is not participating to the leasing
An expected utility maximizing lessee is then selecting the amount of capital $k$ to employ and deciding the share of capital to lease and the share to buy in order to maximize the utility of his future profits:

$$W_d = E_d \left\{ U_d \left[ \frac{f(k) + (1 - \tilde{\delta}_t) c_t (1 - \phi) k}{1 + r_t} - l_t \phi k - c_t (1 - \phi) k \right] \right\}$$  \hspace{1cm} (5.2)

where $\phi$ denotes to the share of leased capital, so that $k_l = \phi k$ and $k_b = (1 - \phi) k$.

$P_d = \frac{f(k) + (1 - \tilde{\delta}_t) c_t (1 - \phi) k}{1 + r_t} - l_t \phi k - c_t (1 - \phi) k$ is the present value of lessee’s random profit, where $f(k)$ is the value of the future production, $(1 - \tilde{\delta}_t) c_t (1 - \phi) k$, is the uncertain future value of the depreciated asset, $l_t \phi k$ is the lease payment, and $c_t (1 - \phi) k$ is the cost of owned capital. Hence the lessee’s maximization problem is

$$\max_{k, \phi} W_d = E_d \left\{ U_d \left[ \frac{f(k) + (1 - \tilde{\delta}_t) c_t (1 - \phi) k}{1 + r_t} - l_t \phi k - c_t (1 - \phi) k \right] \right\}$$

s.t. $E_c \left\{ U_c \left[ \left( l_t^* - c_t + \frac{(1 - \tilde{\delta}_t) c_t}{1 + r_t} \right) \phi k \right] \right\} - U_c(0) = 0$

The Lagrangian for the problem is

$$\mathcal{L} = \int_{-\infty}^{\infty} U_d \left[ \frac{f(k) + (1 - \tilde{\delta}_t) c_t (1 - \phi) k}{1 + r_t} - l_t \phi k - c_t (1 - \phi) k \right] g_d(\tilde{\delta}) d\tilde{\delta}$$

$$+ \lambda \int_{-\infty}^{\infty} U_c \left[ \left( l_t^* - c_t + \frac{(1 - \tilde{\delta}_t) c_t}{1 + r_t} \right) \phi k \right] g_c(\tilde{\delta}) d\tilde{\delta} - U_c(0)$$  \hspace{1cm} (5.3)

where $\lambda$ is the Lagrangian multiplier of the equilibrium rental rate constraint, and $g_d(\tilde{\delta})$ and $g_c(\tilde{\delta})$ are the lessee’s and lessor’s subjective probability density functions of economic depreciation $\tilde{\delta}$. Solving the Euler–Lagrange differential equation for the
maximization problem (5.3) gives

\[ U_d g_d(\delta) - \lambda U_c g_c(\delta) = 0 \]  \hspace{1cm} (5.4)

where \( U'_d = \partial U_d / \partial p_d \) and \( U'_c = \partial U_c / \partial p_c \). Differentiating equation (5.4) with respect to \( \tilde{\delta} \) gives

\[ U''_d c_t(1-\phi)k g_d(\delta) - U'_d g_d(\delta) - \lambda \left( U''_c c_t(1+\phi)k g_c(\delta) - U'_c g_c(\delta) \right) = 0 \]  \hspace{1cm} (5.5)

where \( U''_d = \partial^2 U_d / \partial p_d^2 \), \( U''_c = \partial^2 U_c / \partial p_c^2 \), \( g'_d(\delta) = \partial g_d(\delta) / \partial \delta \), and \( g'_c(\delta) = \partial g_c(\delta) / \partial \delta \). We can now solve equation (5.5) for \( \lambda \) and using the result in (5.4) we obtain

\[ U_d g_d(\delta) - U''_d c_t(1-\phi)k g_d(\delta) - U'_d g_d(\delta) U''_c c_t(1+\phi)k g_c(\delta) - U'_c g_c(\delta) = 0 \]  \hspace{1cm} (5.6)

Solving (5.6) for \( \phi \) gives

\[ \phi = \frac{g'_d(\delta)/g_d(\delta) - g'_c(\delta)/g_c(\delta) + ARAd c_t k}{(ARA_c + ARAd) c_t k} \]  \hspace{1cm} (5.7)

where \(-U'_d / U'_d = ARAd\) and \(-U'_c / U'_d = ARA_c\) are the Arrow–Pratt measures of absolute risk-aversion for the lessor and lessee respectively.

Let us first consider a case where the lessor and lessee have identical subjective expectations about the future economic depreciation, \( g_d(\delta) = g_c(\delta) \), so that \( \phi = \frac{ARAd}{ARA_c + ARAd} = \left[ 1 + \frac{ARA_c}{ARAd} \right]^{-1} \). There are two special cases of particular interest. The first case is when the lessor is risk neutral, \( ARA_c = 0 \), and the lessee is risk averse, \( ARAd > 0 \), then \( \phi = 1 \) and the lessor uses leasing for 100% the capital employed. On the other hand if the lessor is risk averse, \( ARA_c > 0 \), and the lessee is risk neutral, \( ARAd = 0 \), then \( \phi = 0 \) and only owned capital is employed. Between these two extremes there is a continuum of possible financing arrangements where the
more risk averse the lessor is relative to the lessee, the higher is the share of capital leased.

The lessee and the lessor can also have differing expectations about the future economic depreciation. Let us assume that the future economic depreciation is log-normally distributed with \( E_c(\ln \hat{\delta}) = \mu_c \), \( E_d(\ln \hat{\delta}) = \mu_d \) and \( \text{Var}_c(\ln \hat{\delta}) = \text{Var}_d(\ln \hat{\delta}) = \sigma^2 \). That is, the lessor and the lessee have identical estimates of the variance of the depreciation, but their subjective estimates of the mean of the depreciation differ. The log-normality assumption implies that the lessor’s probability density function \( g_d(\hat{\delta}) = \frac{1}{\hat{\delta} \sqrt{2\pi \sigma^2}} \exp\left[ -\frac{1}{2\sigma^2} (\ln \hat{\delta} - \mu_d)^2 \right] \) and hence \( \frac{g_d(\hat{\delta})}{g_d(\hat{\delta})} = \frac{1}{1 + \frac{\ln \hat{\delta} - \mu_d}{\sigma}} \). Using (5.7) we get

\[
\phi = \frac{\frac{\mu_d - \mu_c}{\sigma^2} + ARA_d c_k}{(ARA_c + ARA_d) c_k} \frac{\frac{c_k}{1+r_l}}{1+r_l} \quad (5.8)
\]

When the lessee’s estimate of the mean of the economic depreciation is higher than the lessor’s estimate, \( \mu_d > \mu_c \), the lessee is leasing a higher share of the capital than when the lessor and the lessee have identical expectations. The more pessimistic the lessee is about the future value of the depreciated capital, the higher the share of leasing is on any given level of risk tolerance behavior of the lessor and the lessee.

Hence leasing offers a way to share the risk of uncertain future value of the asset inherent to owning the capital as also presented by Wolfson (1985). In Chapter 4 we, however, concluded that under the assumptions of the CAPM the financing decision is irrelevant and all risk averse agents should be indifferent between leasing and buying. This raises the question as to why a utility maximizing risk adverse agent would strictly prefer leasing to buying as shown above.

The explanation for this lies in the assumptions made when applying the CAPM model. In the theory of firm in a perfect capital market setting, there is no need to introduce a firm utility function. In the context of the CAPM the objective of the firm is to maximize its risk adjusted value that is determined by the markets and it is the role of investors to decide on the shares of various assets in their portfolios so that their utility is maximized (see e.g. Hite, 1979). Fama (1980) has shown that in a frictionless world where information is symmetric and the market for human capital is competitive, a manager maximizing the expected utility of his wealth will
choose policies which maximize the value of the company. When the labor market is perfectly competitive, the value of human capital in terms of future wages equals the marginal productivity of the labor input to the owners of the firm. Hence the objectives of the firm’s owners and managers are aligned despite the separation of ownership and control of the decisions.

Instead, if the information about the management performance is asymmetric, it is possible for the manager to maximize his own utility at the expense of the owner’s of the firm. This can occur when e.g. some type of return on capital type metric is used to determine management’s compensation. Then the management may have an incentive to minimize the risk on near term cash flow as well as the value of the assets, and use leasing even if the cost of lease would be higher than the expected cost of ownership. Furthermore, if the lessee’s access to riskless borrowing is restricted and the assumptions about assets divisibility and liquidity are violated so that the lessee’s possibilities to diversify across a range of investments are also limited, a utility maximizing risk averse agent is not necessarily value maximizing. This is intuitive when the lessee is a consumer, e.g. an individual needing housing. A house or an apartment cannot typically be bought in divisible quantities and the access to mortgage is typically limited by the collateral value of the house. The disconnect between value maximizing and utility maximizing behavior is not, however, limited to the consumer, but may also be applicable in the case of a firm e.g. when the access to risk free borrowing is limited or when the assumption of no taxes is violated. These cases are analyzed more in detail in Chapters 6 and 7.
6 Tax Incentives

One of the key assumptions behind the indifference proposition between leasing and buying is tax neutrality, i.e. all users of capital face the same tax rate. In this section we discuss the incentives for leasing created by the possibility for tax arbitrage. The valuation model discussed was originally introduced by Stewart C. Myers and Bautista (1976), who present a rigorous analytical derivation of the model. The approach presented here, however, follows a more intuitive presentation of Franks and Hodges (1978).

6.1 Lessee’s analysis

Consider first the cash flow resulting from a financial lease contract for capital $k$ covering $n$ periods. The cost of leasing is $l_t$ per unit of capital per period, the lessor makes the lease payments $l_t k$ at the beginning of each period $t \in (1, n)$ and there are no further payments to be made when the lease contract expires at the end of period $n$. The lease payments can be deducted from the lessor’s taxable income and the net payment after taxes is $l_t k (1 - \tau_d)$, where $\tau_d$ is the lessor’s marginal tax rate. The resulting cash flows are illustrated in Figure 6.1 on page 24.

As an alternative to leasing, capital also can be purchased at the price of one per unit at the beginning of the first period, $c_1 = 1$. The cost of purchase is activated to the balance sheet at the time of purchase and the capital investment gives the agent right to depreciation tax shields $d_t k \tau_d$, where $d_t$ is the tax depreciation per unit of capital deductible at the beginning of every period $t \in (1, n)$. The salvage value of the capital $k$ at the end of period $n$ is now assumed to be zero. The cash flow from buying the capital is depicted in Figure 6.2 on page 25.

\footnote{We assume that the depreciation tax shields are taken into account when advance taxes are determined}
In order to finance the purchase, the firm borrows 100% of the funds needed and makes corresponding payments for the interest and principal. The interest payments are made from the profits before taxes so that the effective interest rate is 
\[ r' = r(1 - d) \], where \( r \) is the interest rate at which the firm can borrow. The cash flow from borrowing and making the corresponding repayments is shown in Figure 6.3 on page 26.

The payments to service the debt are made at the beginning of each period \( t \in (2, n) \). By selecting an appropriate repayment schedule, the combined net cash flow of servicing the debt and the depreciation tax shields can be made equal to the cash flow of the financial lease agreement in periods 2 to \( n \) as illustrated in Figure 6.4 on page 27. That is, we set the loan repayment schedule so that \( b_t - d_k r_d = l_t k (1 - \tau_d) \). Solving for \( b_t \), which is the after tax loan repayment and interest at time \( t \), gives \( b_t = l_t k (1 - \tau_d) + d_t k \tau_d \) for all \( t > 1 \).

Let \( B_t \) stand for the amount of debt outstanding at time \( t \) after servicing the debt. Then for each period \( t \), \( B_t = B_{t-1} + r_d B_{t-1} - (b_t + r_d B_{t-1} \tau_d) \), where \( B_{t-1} \) is the loan:

**Figure 6.1:** Time profile: After tax lease payments.
6.1 Lessee’s analysis

Figure 6.2: Time profile: cash flows for purchase.

principal carried over from the previous period, \( r_d B_{t-1} \) is the interest accrued from period \( t - 1 \) to period \( t \), and \( b_t + r_d B_{t-1} \tau_d \) is the repayment and interest before taxes to service the debt at time \( t \). Solving for \( B_{t-1} \) gives

\[
B_{t-1} = \frac{B_t + b_t}{1 + (1 - \tau_d) r_d} = \frac{B_t + b_t}{1 + r_d'}, (6.1)
\]

Hence the value of the loan at time \( t - 1 \) is equal to the present value of the time \( t \) loan principal before repayment discounted using the lessee's effective interest rate \( r_d' \). The debt matures at period \( n \) when the final debt repayment \( b_n \) is made, \( B_n = 0 \), and hence \( B_{n-1} = \frac{b_n}{1 + r_d'} \), \( B_{n-2} = \frac{b_{n-1} + b_{n-1}}{1 + r_d'} = \frac{b_n}{(1 + r_d')} + \frac{b_{n-1}}{1 + r_d'} \), and \( B_{n-3} = \frac{B_{n-2} + b_{n-2}}{1 + r_d'} = \frac{b_n}{(1 + r_d')} + \frac{b_{n-1}}{(1 + r_d')} + \frac{b_{n-2}}{1 + r_d'} \). Following the same logic and applying (6.1) successively gives the value of the initial debt.
Figure 6.3: Time profile: Borrowing and repayment

\[
B_1 = \sum_{t=2}^{n} \frac{b_t}{(1 + r'_d)^{t-1}} = \sum_{t=2}^{n} \frac{l_t (1 - \tau_d)}{(1 + r'_d)^{t-1}} + d_t \tau_d k
\]

where the first equality simply states that the initial loan principal is equal to the present value the future net loan repayments discounted using the lessor’s effective tax rate \(r'_d\). The second equality follows from our requirement that the loan repayment schedule is set so that net loan repayments are equal to the net cost of leasing for periods \(t \in (2, n)\).

From the lessee’s perspective the obligation of the lease payments is similar to the obligation of the loan repayment and the interest. We also assume that if the company is in tax paying position at time \(t\), it can fully utilize the tax shields from either interest payments or lease payments. Therefore, the agent is indifferent between making the after tax lease payments or the payments servicing the debt net of the tax depreciation and interest tax savings all \(t > 1\). Consequently the differences between leasing and buying are fully captured in the cash flow at the
beginning of the first period at time $t = 1$.

When the agent buys the equipment, the net cash flow at the first period is $B_1 - k + d_1 k \tau_d$, i.e. he receives the borrowed funds, pays for the equipment and receives the tax shield from the first period depreciation. For an agent leasing the equipment the first period cash flow is just the first period after tax lease payment $l_1 k (1 - \tau_d)$. The agent should select leasing over buying the capital when the first period cash outflow of buying exceeds the first period cash flow of leasing, that is when $k - B_1 - d_1 k \tau_d > l_1 k (1 - \tau_d) \iff k - \sum_{t=1}^{n} \frac{l_t (1-\tau_d) + d_t \tau_d}{(1 + r_d')}^{t-1} k > 0$. Dividing this result by $k$ gives us the value of leasing contract per unit of capital leased

$$v_d = 1 - \sum_{t=1}^{n} \frac{l_t (1-\tau_d) + d_t \tau_d}{(1 + r_d')}^{t-1}$$

Hence the value of leasing to the lessee, $v_d$, is the net present value of the purchase price minus the after tax lease payments and the forgone depreciation tax shields discounted at the effective after tax interest rate.

\[ \text{(6.2)} \]
Example 6.1. Consider a lease agreement for an asset costing one thousand euros, \( k = 1000 \). A firm can lease the asset for ten periods, \( n = 10 \), with a lease rate \( l_t = 0, 135 \). Alternatively the firm can buy the asset and finance the investment with a loan. The interest rate for the loan, \( r_d = 8\% \) and the firm’s marginal tax rate \( \tau_d = 30\% \) for the duration of the lease agreement. The allowed maximum depreciation for tax purposes is uniform depreciation in 10 periods, \( d_t = 0, 1 \). The cash flows in each of the options are presented in Table 6.1 on page 38. Applying (6.2) gives that the net value \( v_d k \) of the lease agreement for the lessor is 13,75 euros and thus the firm is better off by leasing rather than by taking a loan and buying the asset.

### 6.2 Lessor’s analysis

Now consider the lease contract from the lessor’s perspective. The contract provides the lessor after tax lease payments \( l_t k (1 - \tau_c) \) for all \( t \in (1, n) \). In order to sign the lease contract the lessor first needs to buy capital \( k \) that entitles him to receive the associated depreciation tax shields \( d_t k \tau_c \). The purchase of the capital \( k \) can be financed with a loan where the repayment and the net interest payment \( b_t = l_t k (1 - \tau_c) + d_t k \tau_c \) so that the net cash flow is zero for all \( t \geq 2 \). Therefore, in an analogous way to the lessee’s analysis, the value of the lease contract is completely captured in the cash flows at the beginning of the lease period at time \( t = 1 \). The initial value of the lessor’s debt is \( \sum_{t=2}^{n} \frac{b_t}{(1 + r'_c)^{t-1}} = \sum_{t=2}^{n} \frac{b_t (1 - \tau_c) + d_t \tau_c}{(1 + r'_c)^{t-1}} k \), the purchase cost of capital is \( k \), the first period after tax lease payment is \( l_1 k (1 - \tau_c) \) and the first period depreciation tax shield is \( d_1 k \tau_c \). The value of the lease contract per unit of capital leased for the lessor is then

\[
v_c = \left( \sum_{t=2}^{n} \frac{l_t (1 - \tau_c) + d_t \tau_c}{(1 + r'_c)^{t-1}} k - k + l_1 k (1 - \tau_c) + d_1 k \tau_c \right) k^{-1}
\]

\[
= \sum_{t=1}^{n} \frac{l_t (1 - \tau_c) + d_t \tau_c}{(1 + r'_c)^{t-1}} - 1
\]

(6.3)

where \( r'_c = r_c (1 - \tau_c) \) is the effective interest rate of the lessor. After going through the lessee’s analysis, this result is obvious considering that the cash flows of the lessor are the same as those of the lessee but with opposite signs.
6.3 Net gain to leasing

The lease contract can only take place if the value of the contract is positive for both the lessor and the lessee.

- Example 6.2. Consider again Example 6.1, but now the lessee’s tax rate \( \tau_d = 0 \). The lessor’s tax rate \( \tau_c = 30\% \) and other parameters are as in Example 6.1 \((k = 1000€, n = 10, l_t = 0, 135, d_t = 0, 1\) and \( r_c = r_d = r = 8\% \)). Using (6.2) we get that the lessee’s value of the contract has now increased to 21,67€ as the opportunity cost of tax shields lost has decreased. However, according to (6.3) the lessor’s value for the contract is negative, \(-13,75€\), and a profit maximizing lessor would not be willing to offer a lease contract on these terms. However, if the lease payment is increased to 137,5€ the lessee’s value for the contract would drop to 3,55€ while the lessor’s value for the contract would become marginally profitable, 0,11€, and there would be a positive net gain of 3,66€ for the contract. The time profile of the cash flows for the lessee and the lessor when the lease payment \( l_t k = 137,5€ \) are shown in Table 6.2 on page 39.

The total value of the contract per unit of capital leased is

\[
v = v_d + v_c = \sum_{t=1}^{n} \left[ \frac{l_t (1 - \tau_c) + d_t \tau_c}{(1 + r'_c)^{t-1}} - \frac{l_t (1 - \tau_d) + d_t \tau_d}{(1 + r'_d)^{t-1}} \right]
\]

(6.4)

where the tax depreciation rate \( d_t \) and the lease rate \( l_t \) are obviously the same for both parties of the contract. If both the lessor and the lessee are also facing the same interest rate \( r \), it is easy to see that when \( \tau_c = \tau_d \), the total value of the lease contract is zero as the Modigliani–Miller theorem predicts.

The lessee’s value for the contract can be also written as

\[
v_d = 1 - PV \{ l_t (1 - \tau_d) \} - PV \{ d_t \tau_d \} - PV \{ r \tau_d B_{d,t} \},
\]

(6.5)

where \( PV \{ \} \) refers to the present value of the cash flow indicated in the brackets (Stewart C. Myers and Bautista, 1976, p. 801). The first two terms on the right hand side reflect the difference in the after tax cash flows of buying and making the lease payments. The third term reflects the depreciation tax shields and the
last term the interest tax shields lost by the lessee. In general, when there are differences in the risk characteristics of the cash flows, each one of the cash flows should be discounted using their appropriate risk adjusted interest rates (Samis et al., 2005, Schall, 1974) as was done in Chapter 4. However, the assumption that all the cash flows can be discounted using the same interest rate, $r$, serves as a first approximation and while deriving (6.2) and (6.3) we implicitly made an assumption that the different cash flows fall into same risk class and therefore can be discounted using the same interest rate $r$. Holding this assumption, we can write (6.5) as
and the lessee are facing the same market interest rate $r$ the net value of the before tax cash flows are obviously zero in both cases. The value of the after tax lease payment cash flows are, however, different when their marginal tax rates differ. The lessee can deduct the lease payments from his taxable income and hence delaying the lease payments is a loss in present value for the lessee. On the other hand postponing the lease payments results in deferral of taxes for the lessor, that increases the present value of the after tax lease payments. When the lessor’s marginal tax rate is higher than the marginal tax rate of the lessee, the gain for the lessor is greater than the loss for the lessee and the net present value of deferring the lease payments is positive.

These two mechanisms of tax deferral; interest free tax debt due to accelerated tax depreciation and deferral of the taxable income, offer a vehicle for tax arbitrage where the user of the capital sells the rights to the depreciation tax shields and interest tax savings to the financier. The gain that the lessor and lessee capture is naturally a loss to the government (Stewart C. Myers and Bautista, 1976, p. 813).

Now that we have concluded that cash flows taxed at differing tax rates can create net value to leasing, a question about the impact of interest and tax rates on the value is of natural interest. In order to answer this question and derive some comparative statics we assume a uniform lease rate, $l_t = l$, and differentiate (6.4) with respect to the lease rate $l$ giving:

$$
\frac{\partial v}{\partial l} = \frac{\partial}{\partial l} \sum_{t=1}^{n} \left[ \frac{l(1 - \tau_c) + d_t\tau_c}{(1 + r'_c)^{t-1}} - \frac{l(1 - \tau_d) + d_t\tau_d}{(1 + r'_d)^{t-1}} \right]
$$

$$
= \sum_{t=1}^{n} \left[ \frac{(1 - \tau_c)}{(1 + r'_c)^{t-1}} - \frac{(1 - \tau_d)}{(1 + r'_d)^{t-1}} \right]
$$

$$
= (1 - \tau_c)\frac{(1 + r'_c) - (1 + r'_d)^{1-n}}{r'_c} - (1 - \tau_d)\frac{(1 + r'_d) - (1 + r'_d)^{1-n}}{r'_d}
$$

$$
= \tau_d - \tau_c + \frac{1}{r} \left[ (1 + r'_d)^{1-n} - (1 + r'_c)^{1-n} \right] < 0, \text{ when } \tau_d < \tau_c
$$

where the second equality follows from the properties of geometric series and remembering that $r' = (1 - \tau)r$. Thus the overall value of the lease contract increases as the lease rate decreases and is maximized when the lessor captures all the value. This is intuitive considering that the total value of the contract is derived from the deferral of the taxes and the lower the lease rate the lower the net tax burden on the lease payments. How the value of the lease contract is actually divided between the
lessor and lessee depends on the relative supply of taxable earnings to the supply of excess tax deductions. Assuming competitive and frictionless markets where the supply of excess tax deductions exceeds the supply of taxable earnings all the value of the tax arbitrage is captured by the tax paying lessor companies. Similarly when the supply of taxable earnings is greater than the supply of excess tax deductions the value of the leasing contracts is captured by the non-taxpaying lessees (Franks and Hodges, 1987).

The net gain to leasing is greater the more accelerated the depreciation tax shields are as illustrated in (6.5) where declining balance depreciation schedules with different rates of depreciation $\rho$ are compared to a straight line depreciation. This is intuitive considering that the net gain to leasing is due to net deferral of taxes taking place when the tax depreciation and interest tax shields are accelerated compared to the taxes paid on the lease payments.

The most simple case of accelerated tax depreciation is straight line depreciation, $d_t = d$, and uniform lease rate, $l_t = l$. Using (6.3) we can calculate the lessor’s value with straight line depreciation and uniform lease rate:

$$v_c = \left[ l (1 - \tau_c) + d \tau_c \right] \sum_{t=1}^{n} \frac{1}{(1 + r')^{t-1}} - 1$$

$$= \left[ l (1 - \tau_c) + d \tau_c \right] \frac{1 + r' - (1 + r')^{1-n}}{r'} - 1 \quad (6.7)$$

where the second equality follows from the properties of geometric series. Let us then assume that most of the companies are in tax paying position so that the supply of excess tax deductions is scarce and hence the lessee captures all the value ($v_c = 0$). Using (6.7) we then get the equilibrium lease rate with taxes:

$$l^* = r \frac{(1 + r')^{n-1} - d}{(1 + r')^{n-1} - 1} \frac{\tau_c}{1 - \tau_c} \quad (6.8)$$

Notice that when $\tau_c = 0$, $l^* = r \frac{(1 + r')^{n-1}}{(1 + r')^{n-1} - 1}$, that is exactly the same result we got in the case of uniform equilibrium lease rate without taxes on page 9.

Using (6.2) and (6.8) we get the net gain to leasing per unit of capital with straight line depreciation and uniform lease rate when the lessee captures all the value:
6.3 Net gain to leasing

Figure 6.5: Impact of the allowed tax depreciation schedule on the net gain of leasing. The asset is depreciated in ten years \((n = 10)\) with full write-off of the remaining balance of the asset value at the end of the period and it is assumed that the lessor captures full value of the lease.

\[
v = 1 - \left[ l (1 - \tau_d) + d \tau_d \right] \sum_{t=1}^{n} \left[ \frac{1}{(1 + r_d')^{t-1}} \right] - \left( \frac{1 + r_c'}{1 + r_d'} \right)^{n-1} \frac{(1 + r_d')^n - 1}{1 + r_d'} + \frac{\tau_c - \tau_d}{1 - \tau_c} \frac{(1 + r_d')^n - 1}{r_d' (1 + r_d')^{n-1}} \quad (6.9)
\]

With moderate interest rates \((r \lesssim 15\% )\) the net gain is increasing in \(r\) with all marginal tax rates \(\tau_c\) (Figure 6.6 on page 34). However when the interest rate increases further the net gain of leasing starts to decrease and with high interest rates \((r \gtrsim 30\% )\) the net gain becomes negative. This is because with moderate interest rates higher interest rates increase the value of tax deferral gained through
leasing. When the interest rates increase further the opportunity cost of capital and the value of the interest tax shields increase faster than the gain from tax deferral making leasing less attractive.

Figure 6.6: Net gain of leasing per euro leased with uniform lease rate ($l_t = l$) and straight line depreciation with zero salvage value ($d_t = 1/n$) when the lessee captures all the value and has zero marginal tax rate ($v_d = 0$, $\tau_d = 0$).

Differentiating (6.8) with respect to $\tau_c$ gives:
6.4 Model limitations

\[
\frac{\partial l^*}{\partial \tau_c} = -r^2 \left\{ \frac{(n-1)(1+r'_c)^{n-2}}{(1+r'_c)^n - 1} \right\} - \frac{d}{(1-\tau_c)^2}
\]

\[
= r^2 \frac{(1+r'_c)^{2(n-1)} + (n-1)(1+r'_c)^{n-2}}{[(1+r'_c)^n - 1]^2} - \frac{d}{(1-\tau_c)^2}
\]

that is negative when \( r \) is small relative to \( d \). Hence when interest rates are low compared to the rate of depreciation the equilibrium lease rate is decreasing in lessor’s marginal tax rate \( \tau_c \). Lower lease rates in turn increase the lessee’s gain from leasing as also shown in Figure 6.6 on page 34. This is not only the case when the lessee’s marginal tax rate is zero, but the net gain to leasing is increasing in the difference in marginal tax rates between the lessor and lessee (when the interest rates are moderate) as shown in Figure 6.7. Notice also that the value of a lease contract is positive only when the lessor’s marginal tax rate is greater than the marginal tax rate of the lessee (\( \tau_c > \tau_d \)).

6.4 Model limitations

When deriving the value of the lease contract all the cash flows have been assumed to be certain, that is not, however, always the case with the tax shields. The profits may not always exceed the interest payments and the tax benefits may be canceled in the future. The company may be also forced to reduce it’s debt as a consequence of a reduction in it’s debt capacity reducing the value of the tax breaks. Therefore in reality the size of the benefit is uncertain.

Another limitation in the model of Franks and Hodges (1978) presented above is, that it is assumed that the lessor and the lessee would operate on 100% debt finance. This is not a very realistic assumption and even the companies with the best credit ratings are usually required to finance part of their investments with internal funds. Stewart C. Myers and Bautista (1976) introduce \( \lambda \), a debt displacement factor, in order to take into account debt constraints. If \( \lambda = 1 \), then one euro of capital leased displaces one euro of debt. Assume then that a lessor is financing a fraction \( \lambda \) of the purchase of the equipment with debt. Then the effective interest rate \( r' = r(1-\lambda \tau) \),
as only part of the interest on the investment creates tax shields

Qualitatively the impact of smaller debt displacement factor $\lambda$ is then similar to a lower tax rate. Assuming that the lessor and the lessee are facing the same debt displacement factor, decreasing $\lambda$ has the same impact as decreasing the difference in marginal tax rates. As presented in Section 6.3 the net gain to leasing is increasing in the difference in marginal tax rates, hence the higher the requirement for internal funds, the smaller the net gain to leasing is. The impact of debt constraints is

\[ v = \frac{1}{1+\tau\lambda} \]

\[ \tau = \frac{1}{1+\tau\lambda} \]

\[ r = \frac{r(1+\lambda)}{1+\lambda^2} \]

\[ \tau \lambda y_0 = (1+r(1-\lambda\tau))y_0 \]

\[ r' = r(1-\lambda T) \]

Consider an investment of $y_0$ dollars, where a fraction $\lambda$ of the investment is financed with loan and the rest with internal funds. The interest payment on the loan can be deducted from the taxable income and the equity part carries an opportunity cost of $r$. The value of the investment at the end of period 1 is then $y_1 = y_0 + y_0r - \tau\lambda y_0 = (1+r(1-\lambda\tau))y_0$ and the effective interest rate $r' = r(1-\lambda T)$.
6.4 Model limitations

discussed more in detail in Chapter 7.
Table 6.1: Lease vs. purchase analysis, lessee's cash flow with \( d = 30\% \), \( k = 10\% \). Net value of the loan is 108, 256 € at \( r_d = 8\% \).

### Lease

<table>
<thead>
<tr>
<th>Time</th>
<th>Lease payment</th>
<th>Tax savings</th>
<th>Net cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>1</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>2</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>3</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>4</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>5</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>6</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>7</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>8</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
<tr>
<td>9</td>
<td>-135.00 €</td>
<td>40.50 €</td>
<td>-94.50 €</td>
</tr>
</tbody>
</table>

### Purchase

<table>
<thead>
<tr>
<th>Time</th>
<th>Purchase cost (k)</th>
<th>Depreciation tax savings</th>
<th>Loan repayment</th>
<th>Interest on loan</th>
<th>Interest tax savings</th>
<th>Net cash flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1000 €</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>30.00 €</td>
<td>-79.24 €</td>
<td>-68.94 €</td>
<td>20.68 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>30.00 €</td>
<td>-80.51 €</td>
<td>-62.84 €</td>
<td>18.65 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>30.00 €</td>
<td>-85.02 €</td>
<td>-56.40 €</td>
<td>10.92 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>30.00 €</td>
<td>-89.78 €</td>
<td>-49.80 €</td>
<td>14.88 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>30.00 €</td>
<td>-94.81 €</td>
<td>-42.42 €</td>
<td>12.72 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>30.00 €</td>
<td>-100.12 €</td>
<td>-34.83 €</td>
<td>10.46 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>30.00 €</td>
<td>-105.72 €</td>
<td>-26.82 €</td>
<td>8.05 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>30.00 €</td>
<td>-111.65 €</td>
<td>-18.96 €</td>
<td>5.91 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>30.00 €</td>
<td>-117.90 €</td>
<td>-9.43 €</td>
<td>2.83 €</td>
<td>-94.50 €</td>
<td></td>
</tr>
</tbody>
</table>

### Real Balances

<table>
<thead>
<tr>
<th>Time</th>
<th>Residual value at the beginning of the period</th>
<th>Depreciation</th>
<th>Cumulative depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1000.00 €</td>
<td>100.00 €</td>
<td>100.00 €</td>
</tr>
<tr>
<td>1</td>
<td>900.00 €</td>
<td>100.00 €</td>
<td>200.00 €</td>
</tr>
<tr>
<td>2</td>
<td>800.00 €</td>
<td>100.00 €</td>
<td>300.00 €</td>
</tr>
<tr>
<td>3</td>
<td>700.00 €</td>
<td>100.00 €</td>
<td>400.00 €</td>
</tr>
<tr>
<td>4</td>
<td>600.00 €</td>
<td>100.00 €</td>
<td>500.00 €</td>
</tr>
<tr>
<td>5</td>
<td>500.00 €</td>
<td>100.00 €</td>
<td>600.00 €</td>
</tr>
<tr>
<td>6</td>
<td>400.00 €</td>
<td>100.00 €</td>
<td>700.00 €</td>
</tr>
<tr>
<td>7</td>
<td>300.00 €</td>
<td>100.00 €</td>
<td>800.00 €</td>
</tr>
<tr>
<td>8</td>
<td>200.00 €</td>
<td>100.00 €</td>
<td>900.00 €</td>
</tr>
<tr>
<td>9</td>
<td>100.00 €</td>
<td>100.00 €</td>
<td>1000.00 €</td>
</tr>
</tbody>
</table>

### Loan account

<table>
<thead>
<tr>
<th>Time</th>
<th>Loan balance</th>
<th>Loan repayment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1000.00 €</td>
<td>861.75 €</td>
</tr>
<tr>
<td>1</td>
<td>900.00 €</td>
<td>76.24 €</td>
</tr>
<tr>
<td>2</td>
<td>800.00 €</td>
<td>80.51 €</td>
</tr>
<tr>
<td>3</td>
<td>700.00 €</td>
<td>85.02 €</td>
</tr>
<tr>
<td>4</td>
<td>600.00 €</td>
<td>89.78 €</td>
</tr>
<tr>
<td>5</td>
<td>500.00 €</td>
<td>94.81 €</td>
</tr>
<tr>
<td>6</td>
<td>400.00 €</td>
<td>100.12 €</td>
</tr>
<tr>
<td>7</td>
<td>300.00 €</td>
<td>105.72 €</td>
</tr>
<tr>
<td>8</td>
<td>200.00 €</td>
<td>111.65 €</td>
</tr>
<tr>
<td>9</td>
<td>100.00 €</td>
<td>117.90 €</td>
</tr>
</tbody>
</table>
6.4 Model limitations

| Table 6.2: The net gain to leasing with $d = 0\%$, $c = 30\%$, $k = 1000\varepsilon$, $dt = 0\varepsilon$, and $r = 8\%$. Net value of the lease for the lessee is $156,67\varepsilon \neq 135,\varepsilon = 21,67\varepsilon$, but the lessor’s value for the contract is $\neq 13,75\varepsilon$ and hence a rational lessor would not offer a lease contract on these terms. |  |

<table>
<thead>
<tr>
<th>Lessee Lease</th>
<th>Purchase</th>
<th>Loan account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time t</td>
<td>Lease payment</td>
<td>Tax savings</td>
</tr>
<tr>
<td>0</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>1</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>2</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>3</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>4</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>5</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>6</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>7</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>8</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
<tr>
<td>9</td>
<td>-137.50 €</td>
<td>0.00 €</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lessor Lease income</th>
<th>Purchase</th>
<th>Loan account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lease payment</td>
<td>Taxes on the leasing income</td>
<td>Net cash flow</td>
</tr>
<tr>
<td>0</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>1</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>2</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>3</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>4</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>5</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>6</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>7</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>8</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
<tr>
<td>9</td>
<td>137.50 €</td>
<td>-4.125 €</td>
</tr>
</tbody>
</table>
7 Imperfect Capital Markets

As stated in Chapter 1, the Modigliani–Miller framework assumes that there are no transaction costs, information is symmetric and the companies can borrow any quantities they need to finance their capital investment projects. In real world, however, these assumptions are frequently violated. The purpose of this chapter is to study the impact of the collateral requirements and information asymmetry on why leasing may be the preferred method of financing capital investments.

7.1 Collateral requirements

In case of secured debt the value of the asset required as collateral usually exceeds the value of the loan principal. This is because repossession of the collateralized assets is costly and in order for the lender to secure his claims the value of the collateral needs to cover both the loan principal and the repossession cost. Therefore 100% financing is not possible, but the debtor is required to have internal funds to finance part of the investment.

On the other hand when capital is leased the lessor retains ownership to the asset. In case the lessee defaults on his obligations, the lessor has usually automatically right to repossess the leased asset. As a result transaction costs due to repossession are lower for a lessor than for a secured lender.

7.2 Separation of ownership and control

In financial lease contract the ownership and control of the asset is separated creating a principal-agent problem. In general the principal-agent problems are characterized by a moral hazard due to information asymmetry, where the actions of an individual
cannot be observed or are costly to observe and hence cannot be contracted upon (Holmström, 1979).

Now the moral hazard or incentive problem is created because the ownership and control of the asset are separated. When the user of the asset does not have the right to the asset’s residual value, the incentives for the lessee to take proper care of the asset are less than when the same agent owns and uses the asset and thus bears the full cost of abuse (Smith and Wakeman, 1985, Wolfson, 1985). The information asymmetry arises when the lessor cannot directly observe the use of the asset and therefore the lessor cannot contract to charge according to the real depreciation of the asset. Consequently the lessee is more likely to be careless with the use of the asset and neglect maintenance (Alchian and Demsetz, 1972).

A rational lessor takes this into account and sets the lease payments so that they provide a normal return taking into account the expected lower residual value of the asset. This results in higher lease rates that in turn leads to the further problem of adverse selection. The agents that expect light use the asset will find the lease rates high compared to the purchase price and are more likely to buy the asset. As a consequence the fraction of lessors abusing the asset increases. (Smith and Wakeman, 1985).

Eisfeldt and Rampini (2009) present a valuation model addressing the trade-offs between the benefits of allocating the ownership of the asset to the user minimizing the agency problem, and allocating the ownership to the financier allowing extension of the credit. The following analysis is largely based on Eisfeldt and Rampini’s model, but here we adopt a simplified version of the market for borrowed funds. In Eisfeldt and Rampini’s model borrowing is state contingent, but this is not relevant for the study of relative benefits of leasing over equity finance and therefore it is dropped from the discussion below.¹

¹In Eisfeldt and Rampini’s model state contingent borrowing means that by promising to pay $Rb(s)$ in state $s$ at time 1, the agent can get funds $\pi(s)b(s)$ at time 0 and the agent can decide separately about the amounts $b(L)$ and $b(H)$. The effective interest rate on loan against state $s$ is $R\pi(s)^{-1}$. The state contingency of loans can be interpreted to represent different seniorities of claims or ex-post re-negotiations of loan contracts rendering borrowing effectively state contingent.
7.3 Assumptions

7.3.1 Economy

The economy is defined as a two-period model, where there is a continuum of agents (firms) who at time 0 make investment decisions to capital projects that generate cash flow at time 1. The world at time 1 is uncertain and it can result in one of two states, high \( (H) \) or low \( (L) \). The unconditional probability of state \( s \) at time 0 is \( \pi(s) \), \( s \in (L, H) \). State \( s \) is characteristic to each agent and the agents cannot influence these probabilities by their own actions. The realization of state \( s \) is assumed to be agent’s private information, so that only the agent knows whether his state at time 1 is high or low.

7.3.2 Production Technology

The agents have access to same projects and to same production technology that can be represented by a production function

\[
f(k; a(s), \alpha) = a(s)k^\alpha
\]

where \( a(s) \geq 0 \) is a stochastic productivity that depends on state \( s \), \( k \) is the capital the agent invests at time 0 and \( \alpha \in (0, 1) \) is a scaling parameter of the production function. The price of goods produced is unity so that the cash flow generated at time 1 is \( a(s)k^\alpha \), where \( a(H) > a(L) \). The agents can buy and/or lease production capital, and the bought \( (k_b \geq 0) \) and leased \( (k_l \geq 0) \) capital are perfect substitutes in production, i.e. \( k = k_b + k_l \). Notice that since \( \alpha < 1 \), the production function is concave in \( k \), and the production technology has diminishing marginal return on capital \( k \).

7.3.3 Financing

Capital can be always bought and sold in any quantities at a price of \( c = 1 \) per unit of capital. The purchases of the capital can be partially financed by borrowing using the capital as collateral. The loans are provided by competitive, risk neutral
and perfectly diversified financial intermediaries. As the loan market is perfectly competitive the financial intermediaries make zero profits and since they are perfectly diversified they can always deliver on their promises. Therefore the financial intermediaries need not to be considered explicitly in the model, but they can be considered as banks financed by savings from agents that are running a surplus on their internal funds.

When borrowing funds $b$ at time 0 the agents must promise to pay amount $Rb$ at time 1, where $R = (1 + r)$ is the gross interest rate determined in equilibrium. The agents are restricted to be one of two types: borrowers ($b \geq 0$) or savers ($b \leq 0$). The lenders require full collateral on the agent’s promises to pay, $Rb$. The lender can repossess only a fraction $\theta$ of the value of the depreciated capital when it is repossessed because there is a deadweight cost to repossession. The lender takes this into account when determining the collateral requirements resulting in the following collateral constraint:

$$Rb \leq \theta(1 - \delta)k_b$$

(7.1)

where $\delta \in (0, 1)$ is the rate of economical depreciation of the capital. Therefore the maximum loan an agent can get at time 0 is $b \leq R^{-1}\theta(1 - \delta)k_b$ and the minimum internal funds needed for the purchase are $1 - R^{-1}\theta(1 - \delta)$ per unit of capital purchased.

The repayment of the loan has to be made either from the cash flow from production or with repossessed capital giving the following repayment constraint:

$$Rb \leq a(s)k^\alpha + \theta(1 - \delta)k_r(s), \forall s \in S$$

(7.2)

where $k_r(s) \geq 0$ is the amount of capital repossessed in equilibrium in state $s$. While the lender gets only a fraction $\theta$ of the value of the depreciated capital in repossession, the debtor forfeits the full depreciated value of the repossessed capital. A fraction $(1 - \theta)$ of the value is lost and can be interpreted as the cost of the repossession activities, the deadweight costs, that is now borne solely by the debtor.

The lender’s right to repossess is limited to the capital the debtor owns, imposing a repossession constraint:
7.4 Lessor’s problem

\[ k_r(s) \leq k_b \]  \hspace{1cm} (7.3)

In addition to purchasing, capital can be also leased at rate \( l \) per unit of capital. The lease payment needs to be made in advance so that an agent leasing \( k_l \) units of capital makes a lease payment of \( lk_l \) at time 0. This gives the agent the right to use the capital until time 1, at which point the depreciated leased capital is returned to the lessor and no other payments are made. Hence the repossession technology available for the lessor is superior over the one available for the lender who can only repossess a fraction \( \theta \) of the value of the depreciated capital.

The disadvantage of leasing is that in leasing the ownership and control are separated causing an agency problem. This results in greater wear and tear and the leased capital depreciates faster than owned capital, i.e. \( \delta_l > \delta \), where \( \delta_l \in (0, 1) \) is the rate of depreciation of leased capital. Now it is assumed that \( 1 - \delta_l > \theta(1 - \delta) \), so that the value of depreciated leased capital at time 1 is always greater than the value depreciated purchased capital that a secured lender can repossess.

### 7.4 Lessor’s problem

The leasing market is competitive and the lessors take the leasing rate \( l \) as given. In order to provide capital \( k_l \) to lease at time 0, the lessors need to first buy it. They buy the capital from the same market as all other agents and they face the same prices. The lessor can sell the repossessed depreciated capital \( k_l(1 - \delta_l) \) at a price of 1 per unit of capital at time 1. Moreover it is assumed that the lessor’s have the same requirements for return on their capital as the lenders do so that they discount their cash flow at rate \( R \). A profit maximizing lessor’s problem is then

\[
\max_{k_l} lk_l - k_l + R^{-1}k_l(1 - \delta_l),
\]

where \( l_k \) is the lease payment received at time 0, \( k \) is the cost of the leased capital and \( R^{-1}k_l(1 - \delta_l) \) is the present value of the depreciated leased capital. The first
Chapter 7

Imperfect Capital Markets

order condition for the problem is

\[ l - 1 + R^{-1}(1 - \delta_l) = 0 \]  \hspace{1cm} (7.4)

Solving (7.4) for \( l \) gives the equilibrium lease rate \( l^* = 1 - R^{-1}(1 - \delta_l) \) and the lessors make zero profit at the equilibrium.\(^2\)

### 7.5 Lessee’s problem

The lessee agents are assumed to be risk neutral and their ex-ante preferences are represented by a utility function

\[ \sum_{s \in S} \pi(s) [a(s)k^\alpha + (1 - \delta)k_b - (1 - \delta)(1 - \theta)k_r(s) - Rb] \]  \hspace{1cm} (7.5)

The first term inside the brackets is the cash flow from the capital investment in state \( s \) at time 1, the second term is the value of depreciated owned capital, the third term is the deadweight cost of repossession and the last term is the repayment of debt. That is the agent’s utility is represented by the expected value of their investment decision. The agent’s budget constraint at time 0 is

\[ e + b = lk_l + k_b \]  \hspace{1cm} (7.6)

i.e. the agent’s initial endowment, \( e \), plus his net debt has to equal the sum of the lease payment and the cost of purchased capital.\(^3\)

\(^2\)Notice that the lessors net financing need at time 0 is \( k_l - lk_l = R^{-1}(1 - \delta_l)k_l \), where the first term on the left hand side is the purchasing cost of the asset to be leased and the second term is the lease payment the lessor receives at the beginning of the lease period.

\(^3\)This is different from the preferences and budget constraint presented by Eisfeldt and Rampini. In their model the agents can pay dividends and the agent’s objective is to maximize the sum of (non-discounted) dividends over time. The utility function (7.5) lacks the intuitive appeal of representing the present value of future dividend stream and thus being the classical company
The agent takes the leasing cost \( l \) and the interest rate \( R \) as given and chooses the amount of capital to lease, \( k_l \), the amount of capital to buy, \( k_b \), the amount of capital allowed to be repossessed, \( k_r(s) \), to repay the loan at each state \( s \), and the amount to borrow or save, \( b \), so that it maximizes the expected value of investment (7.5) at time 1 subject to constraints (7.1) - (7.3) and (7.6).

### 7.5.1 Lease or buy

Consider first a scenario where the agent can finance a capital investment only either by leasing or borrowing, but financing an investment using any combination of leasing and debt is not allowed. The cash flows and costs of these alternative financing options are illustrated in Figure 7.1 on page 47.

![Figure 7.1: Lease or buy](image)

We are assuming that the cost of leased capital \( C_L(k_l) = R l k_l \) is always higher than the cost of capital financed with debt, \( C_B(k_b) = [R - (1 - \delta)] k_b + (1 - \delta)(1 - \theta) k_r(s) \), valuation formula. Eisfeldt and Rampini, however, assume implicitly that the shareholders, who receive the dividends at time 0 would save them whereas here the unconstrained agents save the funds themselves. Furthermore by assuming that the agents don’t discount the dividends at time 1, Eisfeldt and Rampini ensure that the time 0 dividends are zero. Therefore the preferences represented by (7.5) and budget constraint (7.6) are equivalent to the model of Eisfeldt and Rampini.
but the amount the agents can borrow is limited by the requirement for full collateral on the loan. Since only a fraction $\theta$ of the value of the depreciated capital can be used as collateral, the maximum loan the agent can get at time 0 with capital $k_b$ as collateral is $b = R^{-1} \theta (1 - \delta) k_b$. Thus the minimum need for internal funds per unit of owned capital is $1 - R^{-1} \theta (1 - \delta)$ that is greater than the equilibrium leasing rate $l = 1 - R^{-1} \theta (1 - \delta_l)$ given our assumption $\delta_l > \delta$. Hence leasing allows agents with limited internal funds to expand their capacity faster than when relying on borrowing the additional funds needed for the investment.

The agents with the least internal funds are severely constrained by the collateral requirements. In Figure 7.1 on page 47 $k_0$ is the level of capital the agent could finance with debt and the corresponding expected revenue is $F(k_0) = \sum_{s \in S} \pi(s)a(s)k_0^s$. Using more costly leasing the agent can, however, reach capital level $k_1$ and expected cash flow $F(k_1)$. The expected profit at point $k_1$ is CD that is greater than the profit that can be achieved at point $k_0$, and thus a profit maximizing agent is leasing all its capital.

Consider then an agent with higher internal funds that enable financing capital $k_2$ using debt. Now the expected profit is ef and even though the agent could get access to more capital by using leasing he cannot increase his expected profits because of the higher cost of leased capital and diminishing marginal returns on capital investment.

### 7.5.2 Lease and buy

When an investment can be financed using both leasing and debt at the same time, we can write the Lagrangian for the lessee’s maximization problem

$$\mathcal{L}(k_l, k_b, k_r(s), b) = \sum_{s \in S} \pi(s) \left[ a(s)k^s + (1 - \delta)k_b - (1 - \delta)(1 - \theta)k_r(s) - Rb \right]$$

$$+ \mu_0 \left[ e + b - lk_l - k_b \right]$$

$$+ \lambda_c \left[ \theta (1 - \delta) k_b - Rb \right] + \sum_{s \in S} \lambda_p(s) \left[ a(s)k^s + \theta (1 - \delta)k_r(s) - Rb \right]$$

$$+ \sum_{s \in S} \lambda_r(s) \left[ k_b - k_r(s) \right]$$

$$+ \xi_k k_l + \xi_b k_b + \sum_{s \in S} \xi_r(s) k_r(s)$$
In order to simplify the problem we assume that the cash flow at time 1 in state \( L \) is zero, i.e. \( a(L) = 0 \), and the only option for and agent in state \( L \) is to repay with repossessed capital. The agent is strictly better off by paying the minimal amount possible and thus the repayment constraint in low state must be always binding. Furthermore we also make an assumption that in state \( H \) the cash flow generated is greater than the depreciated value of the capital, i.e. \( a(H)k^\alpha > (1 - \delta)k \). Combining this with the collateral constraint (7.1) gives then \( a(H)k^\alpha > (1 - \delta)(kl + kb) > \theta(1 - \delta)kb \geq Rb(H) \) so that the repayment constraint is a slack in the state \( H \) and \( \lambda_p(H) = 0 \). Moreover, when the cash flow alone is greater than the repayment, \( a(H)k^\alpha > Rb(H) \), there is no repossession in state \( H \) since allowing repossession would diminish the agent’s utility due to the dead weight cost involved. Hence \( k_r(H) = 0 \) which also implies that in state \( H \) the repossession constraint is redundant and we can set \( \lambda_r(H) = 0 \).

Since the objective function is linear and the constraint set is convex the first order conditions for the problem are necessary and sufficient. Furthermore due to the nature of the problem the budget constraint is always binding. The Kuhn–Tucker first order conditions for the optimal solution can be now written as

\[
\mu_0 l = \pi(H)\alpha a(H)k^{\alpha-1} + \xi_l \tag{7.7}
\]

\[
\mu_0 = \pi(H)\alpha a(H)k^{\alpha-1} + (1 - \delta) + \lambda_c\theta(1 - \delta) + \lambda_r(L) + \xi_b \tag{7.8}
\]

\[
\pi(L)(1 - \delta)(1 - \theta) = \lambda_p(L)\theta(1 - \delta) - \lambda_r(L) + \xi_r(L) \tag{7.9}
\]

\[
\mu_0 = [1 + \lambda_c + \lambda_p(L)] R \tag{7.10}
\]
\[ e + b - l k_l - k_b = 0 \] (7.11)

\[ \lambda_c [\theta(1 - \delta)k_b - Rb] = 0 \] (7.12)

\[ \theta(1 - \delta)k_b \geq Rb \] (7.13)

\[ a(H)k^\alpha \geq Rb \] (7.14)

\[ \theta(1 - \delta)k_r(L) = Rb \] (7.15)

\[ \lambda_r(L) [k_b - k_r(L)] = 0 \] (7.16)

\[ k_b \geq k_r(L) \] (7.17)

\[ \xi_l k_l = \xi_b k_b = \xi_r(L) k_r(L) = 0 \] (7.18)

\[ k_l \geq 0, \ k_b \geq 0, \ k_r(L) \geq 0 \] (7.19)

As we saw in Section 7.5.1 the agent’s optimal choice is determined by the availability of his internal funds. The degree into which the agent is constrained is characterized
by the multiplier of time 0 budget constraint, where large values of $\mu_0$ are associated with most constrained agents.\footnote{Associating large values of $\mu_0$ with most constrained agents is consistent with the interpretation of $\mu_0$ as the shadow price of the time 0 budget constraint. The higher the shadow price the higher the marginal value of the internal funds are for the agent.}

The agents with least internal funds lease all their capital, $k_l > 0$, $\xi_t = 0$ and $k_b = 0$. Using (7.7) we get $\mu_0 = \frac{\pi(H)\alpha a(H)k^{\alpha-1}}{l}$, where the numerator $\pi(H)\alpha a(H)k^{\alpha-1}$ is the expected marginal return of the production on capital and the lease rate $l$ is the marginal cost of capital. Hence $\mu_0$ can be interpreted as the marginal return on internal funds, that is the shadow price of internal funds. Using (7.11) and remembering that $k_b = 0$ we get $k = k_l = e/l$ so that amount of capital invested is increasing with endowment.

As the amount of total capital invested, $k$, increases the marginal return on additional capital investment into production technology diminishes and eventually reaches a point where the cost of leased capital no more justifies the faster expansion of productive capital allowed by leasing. However, agents with higher internal funds can also use debt to finance their capital investment needs, $k_l > 0$, $k_b > 0$ and $\xi_t = \xi_b = 0$. They borrow the maximum amount they can, and in low state they have to repay with repossessed capital as they don’t have any cash flow. Thus collateral constraint (7.13) and repossession constraint (7.17) are binding, and $k_r(L) = k_b > 0$ and $\xi_r(L) = 0$. Using (7.7), (7.8), (7.9) and (7.10) we get $\mu_1 = \frac{R\pi(H)(1-\delta)(1-\theta)}{1-\delta_l-\theta(1-\delta)}$. Remembering that $\mu_0$ is the marginal return on internal funds this result has the following intuitive interpretation: substituting one unit of leased capital with owned capital at time 0 requires additional internal funds of $(1 - R^{-1}(1 - \delta)) - l = (1 - R^{-1}(1 - \delta)) - (1 - R^{-1}(1 - \delta_l)) = R^{-1}(1 - \delta_l - \theta(1 - \delta))$, but gives the agent at time 1 in state $H$ the share of depreciated capital financed with internal funds $(1 - \theta)(1 - \delta)$. Notice that $\mu_1$ does not depend on $e$ and thus the agent keeps the amount of capital constant and uses any additional internal funds to substitute away from leased capital by borrowing and buying the capital.

The amount of leased capital, $k_l$, an agent has reaches its maximum just before an agent with increasing internal funds starts to replace capital with debt, i.e. when $\mu_0$ approaches $\mu_1$ from above. Solving $\frac{\pi(H)\alpha a(H)k^{\alpha-1}}{1-\delta_l-\theta(1-\delta)} = \frac{R\pi(H)(1-\delta)(1-\theta)}{1-\delta_l-\theta(1-\delta)}$ for $k$ gives the maximum amount of leased capital.
The substitution of leased capital with owned capital continues until the agent owns all the capital, \( k_l = 0 \). He is still maximizing the debt within the limits of the collateral constraint and all the capital is repossessed in state \( L \), \( k_l = 0, k_b > 0 \) and \( \xi_b = 0, \theta(1 - \delta)k_b = Rb, k_r(L) > 0 \) and \( \xi_r(L) = 0 \). Using now (7.8), (7.9) and (7.10) we get \( \mu_0 = \pi(H)(\alpha a(H)k^{\alpha-1}+(1-\theta)(1-\delta)) \), where \( k = \frac{e}{1-R^{-1}\theta(1-\delta)} \). The numerator in \( \mu_0 \) is the marginal return on capital that is externally financed \( \pi(H)(\alpha a(H)k^{\alpha-1}+(1-\theta)(1-\delta)) \), i.e. the expected cash flow plus the expected value of the depreciated capital financed with external funds. The denominator is the cost of capital in terms of internal funds \( 1 - R^{-1}\theta(1-\delta) \). Notice that since \( k = \frac{e}{1-R^{-1}\theta(1-\delta)} \), the agent is again investing into more capital when the amount of internal funds, \( e \), increase.

The production technology has diminishing marginal return on capital and when the amount of invested capital gets sufficiently high, it is no more economical to expand and invest into more production capital using external funds. This is because external funds carry the associated deadweight cost of repossession with them. When the share of internal funds in investment increases, the collateral constraint is no more binding and \( \lambda_e = 0 \). Using (7.13) and (7.15) we get \( k_b > k_r(L) \Rightarrow \lambda_r(L) = 0 \). Hence the repossession constraint is a slack and only a fraction of the capital is repossessed in low state lowering the repossession costs. Notice, however, that as long as debt is used capital will be repossessed in low state so that \( k_r(L) > 0 \) and \( \xi_r(L) = 0 \). Together with (7.9) and (7.10) this implies \( \mu_0^2 = \left[ \pi(H) + \theta^{-1}\pi(L) \right] R = \frac{\pi(L)(1-\theta)(1-\delta)+\theta(1-\delta)}{R^{-1}\theta(1-\delta)} \), is the cost of substituting debt with internal funds, \( \pi(L)(1-\theta)(1-\delta) \) is the expected savings on repossession costs and \( \theta(1-\delta) = Rb k_b^{-1} \) is the marginal interest saving on lower debt. Notice that \( \mu_0^2 \) is independent of the amount of internal funds \( e \) and hence the agent keeps the total amount invested capital constant and uses any additional internal funds to replace debt.

The substitution of debt with internal funds continues until \( b = 0 \). After that the agent starts to invest into new capital again, but this time using only internal funds, that is \( k_l = 0, b = 0, k_b > 0 \) and \( \xi_b = 0 \). Furthermore as the agent is not using debt the collateral constraint is not binding, \( \lambda_e = 0 \), and there is no
repossession, \( \lambda_r(L) = 0 \). Using (7.8) and (7.11) we get the return on internal funds, 
\[ \mu_0 = \pi(H)\alpha a(H)e^{\alpha - 1} + (1 - \delta) \] , that is the expected marginal production plus the value of depreciated capital. The investment into additional capital using internal funds continues until \( \mu_0^3 = R \) . When \( \mu_0 \) becomes smaller than \( R \), investing more internal funds to production capital gives lower return than the capital markets are offering and therefore the agent is better off by saving any additional internal funds.

## 7.6 Equilibrium

In Section 7.4 we showed that there is a leasing rate at which there are lessor’s willing to offer financial lease contracts. In Section 7.5 we showed that firms with limited internal funds but good growth prospects prefer leasing over secured debt, and the fraction of leased capital is decreasing in the amount of internal funds available. An equilibrium is defined by interest rate \( R \), leasing rate \( \ell = 1 - R^{-1}(1 - \delta) \) and a capital allocation where the firms maximize their utility taking interest rate and leasing rate while the capital market clears

\[
\sum_{e \in E} p(e) \sum_{s \in S} \pi(s)b(s; e) + \sum_{e \in E} p(e)R^{-1}k_\ell(e)(1 - \delta) = 0
\]

where \( p(e) \) is the density of agents with endowment \( e \). The first term on the left is aggregate direct net debt in the economy held by the agents and the second term is the total amount of financing required by the leasing firms.

The extent into which leasing is utilized is thus dependent on the distribution of internal funds across the agents. The more there are firms with limited internal funds the more leasing we should expect to see. Limited internal funds are also likely to be correlated with low tax rates. Therefore the tax incentives discussed in Chapter 6 are likely to benefit the same firms that resort to leasing because of lack of internal funds.

The amount of leased capital is also increasing in the collateral requirement, that can be seen by differentiating (7.20) with respect to \( \theta \),

\[
\frac{\partial k_{l,\text{max}}}{\partial \theta} = \frac{\delta - \delta\ell}{(1 - \theta)(1 - \alpha)(1 - \delta - \theta(1 - \delta))}k_{l,\text{max}} < 0.
\]

Thus the higher the repossession cost and consequently the higher the collateral requirement (smaller \( \theta \)), the more the agents are expected to use leased capital.
Higher collateral requirement increases the leverage for faster capital expansion offered by leasing making it more lucrative for agents with limited internal funds. This finding is also aligned with the conclusions on the impact of equity requirements in Chapter 6.

Differentiating $k_{l,max}$ with respect to $R$ gives

$$\frac{\partial k_{l,max}}{\partial R} = \frac{k_{l,max}}{(R+\delta_i-1)(1-\alpha)} < 0,$$

and hence other things equal the extent of leasing should be decreasing in interest rates, that is the opposite to the prediction we got in Chapter 6 when considering the tax incentives for leasing. When the interest rates are increasing the cost of debt increases and the present value of the salvage value of the capital decreases, both influencing the return on internal funds negatively when investment is financed with debt. The equilibrium lease rate $l$ is, however, also dependent on $R$, and increases faster than the cost of debt in terms of internal funds when $R$ is increasing.
8 Conclusions

The objective of this thesis has been to try to identify the reasons and the underlying conditions for leasing being preferred to owning when financing capital investment projects.

First we showed that in a neoclassical world where the assumptions of the Modigliani–Miller and the CAPM theorems hold, there are no purely financial reasons to either lease or own assets and hence all the agents should be indifferent between owning and leasing.

When relaxing the CAPM value maximization framework we found that a utility maximizing risk averse agent would prefer leasing to owning an asset when there is uncertainty in the residual value of the asset, and when the lease terms offered by a risk neutral or less risk averse lessor operating in a competitive leasing market. Another case when leasing would be also preferred to owning is when the lessee has a lower expectation about the future value of the asset that the lessor. Avoiding the risk in the future value of the property could be one of the reasons explaining why leasing so common in housing services. The variation in property prices are often large compared to the wealth of households and rental apartments offer a way for individuals to avoid the inherent risk in property prices.

Another reason to prefer leasing to owning that is also intuitive in the context of housing services is limitations on access to financial markets. More specifically when the user of an asset can borrow only limited amounts and has to finance part of the purchase with internal funds, leasing can provide access to faster capacity expansion and higher utility than would be possible with owned assets. This is not however limited to utility maximizing individuals but also applies to value maximizing firms.

Finally we also presented how taxation and accelerated schedule for tax depreciation can provide an incentive for leasing. When using leased assets a firm with a lower marginal tax rate can transfer the right to the tax shields to a firm with higher marginal tax rate. The potential for the tax arbitrage from leasing is greater the
greater the spread in marginal tax rates and hence we should expect to see decline in
the share of leasing used by firms as many industrialized countries including Finland
are lowering their corporate tax rates. At the same time, however, the higher capital
requirements imposed on banks are translating into stricter lending standards and
hence higher collateral requirements, that is likely to increase the popularity of
leasing.

The value of the tax arbitrage gained through the present value of accelerated tax
depreciation is however relatively small in case of e.g. Finnish corporate tax rates
and normal interest rates and hence the tax incentive to leasing is not likely to be
very significant factor except perhaps in the largest investment projects.
Bibliography


