Why Firms Lease Short-Lived Assets: A Tax-Based Explanation

Ling Chu, Robert Mathieu, and Ping Zhang*

Abstract
The authors examine the impact of assets' useful lives on firms' leasing decisions in Canada. Their theoretical analysis demonstrates that firms are more likely to lease assets with shorter useful lives. More specifically, they show that in a competitive financing market, lease payments are a decreasing function of lessors' tax rates. Therefore, the useful life of an asset is relevant in leasing decisions because lessors' tax rates are less likely to remain at the highest level over a longer horizon, leading to higher leasing costs and less leasing activity. Using a sample of publicly traded Canadian companies, the authors also provide empirical evidence that the useful life of an asset is negatively associated with the proportion of assets leased by a firm.

Keywords: Leases ■ Capital Cost Allowance ■ CCA ■ Capital Investments

* Ling Chu and Robert Mathieu are of the School of Business & Economics at Wilfrid Laurier University, Waterloo, Ontario; Ping Zhang is of the Rotman School of Management at the University of Toronto. The authors would like to thank Theresa Libby, Alan Macnaughton, three anonymous referees, and participants at the European Accounting Association 2008 annual conference for their helpful comments. Financial support for this project was provided by the CA/Laurier Centre for the Advancement of Accounting Research and Education and by the Social Sciences and Humanities Research Council of Canada.
For most firms, lease liabilities account for a significant portion of total liabilities. The Equipment Leasing Association states in a recent survey that 8 out of 10 companies lease some or all of their equipment. In fact, the lease liability has been determined to represent more than 40 percent of all fixed claims for the average firm where fixed claims are defined as the sum of the book value of all long-term debt, the book value of all capital leases, and the present value of all future operating lease obligations.  

Therefore, it is important to understand in what situations leasing is a cheaper form of financing than direct borrowing. In this article, we investigate the relationship between tax-related leasing costs and assets’ useful lives both theoretically and empirically.

Previous theoretical and empirical studies considering the effect of taxes on leasing decisions include Miller and Upton; Myers, Dill, and Bautista; Ang and Peterson;
Krishnan and Moyer;\textsuperscript{5} Shanker;\textsuperscript{6} and Graham, Lemmon, and Schallheim.\textsuperscript{7} However, these studies do not consider the impact of assets’ useful lives on firms’ leasing decisions. The main objective of this article is to examine the impact of assets’ useful lives on the leasing decisions under the current Canadian income tax law. In our analysis, we relate tax rate uncertainty in future periods to the costs and benefits of leasing. We then empirically test our predictions using a sample of firms traded on the Toronto Stock Exchange (TSX) in the 2005 fiscal year. This analysis is particularly useful for tax practitioners who assist their clients with the decisions on whether to lease or buy assets.

Empirical studies have tested earlier models that predicted a greater use of leases by firms with low tax rates. Evidence on this topic is mixed. While some studies fail to support the existence of a negative relationship between the tax rate and the use of leases,\textsuperscript{8} more recent work documents evidence consistent with earlier models. For example, Sharpe and Nguyen\textsuperscript{9} use the presence of operating loss carryforwards to proxy for firms’ marginal tax rates. Their results indicate that firms with loss carryforwards (that is, low tax rate) have more leases. Graham, Lemmon, and Schallheim\textsuperscript{10} avoid endogeneity problems in measuring tax by using tax rates before considering the financing effects. Using this measure, they provide evidence of a negative association between the use of leases and tax rates. Using Canadian data, Shanker\textsuperscript{11} also examines the association between tax rates and the use of leases. She finds that firms with higher marginal tax rates are less likely to use leases.

Our study contributes to the literature in several ways. First, we develop a multi-period model that allows for uncertainty in the lessors’ future tax rates. Thus, we are able to predict that leasing decisions are negatively affected by assets’ useful lives. We then empirically test our prediction. To our knowledge, this is the first article to study the relationship between assets’ useful lives and the lease decisions. The empirical analysis provides evidence that the useful lives of assets are negatively associated with the proportion of leases held by firms in our sample. These results suggest that assets with longer useful lives are less likely to be leased. The coefficient on the discount rate is insignificantly consistent with our expectation that the impact

\textsuperscript{8} See, for example, Ang and Peterson, supra note 4, and Krishnan and Moyer, supra note 5.
\textsuperscript{10} Supra note 7.
\textsuperscript{11} Supra note 6.
of this variable in the decision is marginal. Also consistent with our expectation, the
tax variables are insignificant. Finally, other variables such as leverage ratio, working
capital, proportion of capital assets, and size of the firm affect the decision to lease
assets.

The article proceeds as follows. We discuss the tax treatments of leases in the
next section and then we introduce our model. We present the empirical tests of our
theoretical prediction and finally we make concluding remarks.

TAX TREATMENT OF LEASES IN CANADA

A lease is a contract allowing a firm (the lessee) to use an asset that is the property
of another party (the lessor) in exchange for lease payments. At the end of the lease
term, the asset can be returned to the lessor, and the lessee may or may not guaran-
tee the residual value. Alternatively, the ownership of the asset can be transferred to
the lessee at the end of the lease term through a bargain purchase option or without
conditions. Although the lessor retains the legal ownership of the asset throughout
the lease term, the lease conditions could be such that the lessee enjoys most of the
benefits associated with the ownership of the asset.

A contract can be treated as a true lease or a purchase for tax purposes, depend-
ing on the terms of the contract. The distinction between lease and purchase has a
direct impact on the tax treatment. In general, the Canadian tax treatment for a true
lease is as follows: the lessee deducts the lease payments as lease expenses, and the
lessor recognizes the rental income and deducts from it the capital cost allowance
(CCA) and other related expenses. If the legal relationship in the contract is a pur-
chase, the acquiring firm deducts the CCA and the interest expense, and the selling
firm recognizes a gain or loss, which may be a capital gain or business income de-
pending on the nature of the asset and other factors.

The determination of a transaction as “lease or purchase” for tax purposes has
evolved over many years. The Canada Revenue Agency’s (CRA’s) Interpretation Bul-
letin IT-233R12 was intended to stop abuses in lease arrangement situations where the
economic substance of the transactions between the parties reflected a sale, but
the legal form was a lease. IT-233R clearly suggested a substance-over-form doctrine,
which has also been used in the Canadian accounting standards for the classification
of leases. In particular, the interpretation bulletin set out four situations that would
be considered capital leases rather than operating leases:

1. the lessee automatically acquires title after payment of a specified amount in
   the form of rentals;
2. the lessee is required to buy the property before or at lease-end or at the ter-
   mination of the lease, or is required to guarantee that the lessor will receive

12 Interpretation Bulletin IT-233R, “Lease-Option Agreements; Sale-Leaseback Agreements,”
February 11, 1983.
the full option price from the lessee or third party (except where such guarantee is given only in respect of excess wear and tear inflicted by the lessee);
3. the lessee has the right during or at lease-end to buy the property at an option price that at the inception of the lease is substantially less than the probable fair market value at the option date; or
4. the lessee has the right during or at lease-end to buy the property at an option price or under terms and conditions that at the lease’s inception are such that no reasonable person would fail to exercise such option.\(^{13}\)

On the basis of the above, if the economic substance of a lease contract is not a true lease but a purchase from the lessee’s perspective, then it is treated as a capital lease. The tax consequences are the same as with any other purchase on credit or instalment sales. These situations show that the legal relationship of a contract is not the only factor to differentiate operating leases and capital leases for tax purposes.

Principles used in the determination of lease or purchase status evolved further after the \textit{Shell} case.\(^{14}\) In \textit{Shell}, the Supreme Court of Canada stated,

\[\text{T]his Court has never held that the economic realities of a situation can be used to recharacterize a taxpayer’s \textit{bona fide} legal relationships. To the contrary, we have held that, absent a specific provision of the Act to the contrary or a finding that they are a sham, the taxpayer’s legal relationship must be respected in tax cases. Recharacterization is only permissible if the label attached by the taxpayer to the particular transaction does not properly reflect its actual legal effect.}\(^{15}\)

As a result of the \textit{Shell} case, IT-233R was cancelled on June 14, 2001.\(^{16}\) The CRA stated that the determination of whether a contract is a lease or a purchase is based on the legal relationships created by the terms of the particular agreement, rather than on any attempt to ascertain the underlying economic reality. In addition, at the Canadian Tax Foundation’s 2000 annual conference, CRA officials stated that the legal relationship between the parties to the contract distinguishes between a true lease and a purchase, not simply the document’s self-referencing as a lease or a buy.\(^{17}\) Automatic ownership of property after some rent is paid is viewed as a conditional or instalment purchase and not as a lease. The CRA further stated that its policy on the general anti-avoidance rule (GAAR)\(^{18}\) remains unchanged: it will continue to apply

\(^{13}\) Ibid., at paragraph 3.

\(^{14}\) \textit{Shell Canada Limited v. The Queen et al.}, 99 DTC 5669 (SCC).

\(^{15}\) Ibid., at paragraph 39.


\(^{18}\) Section 245 of the Income Tax Act, RSC 1985, c. 1 (5th Supp.), as amended (herein referred to as “the Act”). Unless otherwise indicated, statutory references in this article are to the Act.
GAAR in abusive avoidance transactions. It seems clear that a recharacterization is only permitted if the particular transaction does not properly reflect its actual legal substance.

In recent years, the CRA has followed the principles established in Shell in its assessments. For example, in its ruling dated July 10, 2002, one of the issues to be determined was whether a particular agreement will be considered a lease such that the payments made under the terms of the agreement will be deductible for tax purposes. Using case law, the CRA looked at whether there had been a purchase under the law; in other words, does the taxpayer have title to, or the incidents of title and rights in, the asset, not just rights in a contract relating to the asset.

Due to the outcome of the Shell case and the cancellation of IT-233R, there are no longer any capital leases for tax purposes on the basis of economic substance. Legal relationship is the only determining factor for the lease versus purchase decision. Specifically, where there is no transfer of legal title of the property in the lease agreement, the lease is treated as an operating lease. On the other hand, if at any time the legal title has been transferred during the lease term, the transaction is treated as a purchase at the time of the transfer.

**Specified Leasing Property Rules**

In 1989, Canada adopted the specified leasing property rules to eliminate the CCA benefits to lessors on certain types of assets. These rules effectively bifurcate the lease market into two main segments: exempt and non-exempt assets. Exempt assets include general purpose office furniture and office equipment, such as computers, residential equipments, passenger vehicles, vans, trucks, and rail cars. Non-exempt assets constitute the remainder, such as industrial machinery, vessels, energy generation assets, oil and gas equipment, flight simulators, and telephone switching assets.

A lessor of exempt assets is entitled to full CCA. A lessor of non-exempt assets is limited to a CCA deduction equal to the lesser of (1) full CCA and (2) the notional amount of principal it would receive if the lease were treated as a loan of an amount equal to the fair value of the leased property, with interest at a prescribed rate based on long-term government of Canada bond rates. Therefore, the CCA deductible for non-exempt assets could be lower than the prescribed CCA.

The lessee is treated as paying rent and is not affected by the specified leasing property rules. However, if the lessee and lessor make an election under section 16.1, the lessee is treated as the owner of the equipment for the purpose of calculating its income for tax purposes and is entitled to treat the rent payment as a blend of principal and deductible interest. To make a valid section 16.1 election, the lessor and lessee must deal at arm’s length, and the lessor must be a resident of Canada or a non-resident carrying on business through a permanent establishment in Canada that is not tax-exempt.

---


20 MNR v. Wardean Drilling Ltd., 69 DTC 5194 (Ex. Ct.).
It would be interesting to control for assets leased under specified leasing property in our empirical analysis. We used a random sample of 30 firms (27 percent of our sample) in different industries to search for this information in the notes on operating and capital leases, notes on other items in the financial statements, and the remaining part of the annual reports. We find no evidence of any discussion by firms on specified leasing property in the annual reports. Therefore, empirically we cannot identify and control for specified leasing property. Similarly, our theoretical model developed in the following section does not apply to assets leased under specified leasing property.

**THE THEORETICAL ANALYSIS**

**The Setting**

In our analysis, we assume the following simplified setting. First, assume that a firm needs an asset to undertake a project. The firm (referred to as the user of the asset) has two alternative financing methods to obtain the asset: leasing the asset or borrowing funds to purchase the asset. If the asset is purchased with borrowed funds, the net present value of the project, $NPV_p$, is

$$NPV_p = PV\ (\text{net cash flows from the project before considering the cash flows related to the purchase}) + PV\ (\text{net cash flows impact of buying the asset}) + PV\ (\text{residual value of the asset}).$$

The net cash flow impact of buying the asset (the second component) is composed of three elements: (1) the before-tax present value of cash outflows from buying the asset (the cost of the asset), (2) the present value of the tax savings from the deduction of the interest expense, and (3) the tax shield from CCA deductions associated with the purchase of the asset.

Alternatively, when the firm leases the asset, the net present value of the project, $NPV_L$, is

$$NPV_L = PV\ (\text{net cash flows from the project before considering the impact of leasing the asset}) + PV\ (\text{net cash flows impact of leasing the asset}).$$

The net cash flow impact of leasing the asset (the second component) is composed of two elements: (1) the before-tax present value of cash outflows from leasing the asset (the present value of the minimum lease payments); and (2) the present value of the tax savings from lease payment.

Assume that the use of the asset is independent of the decision to buy or lease. Therefore, the net cash flows generated from the project are the same under both alternatives. Furthermore, the before-tax present value of cash outflows from buying the asset (the cost of the asset) less the present value of the residual value of the asset should be very close to or equal to the before-tax present value of cash outflows from leasing the asset (the present value of the minimum lease payments). Consequently, to compare the benefits of leasing and buying the asset, we can focus
on the tax consequences of buying (deductibility of interest expense and the CCA tax shield) and leasing the asset (deductibility of lease expenses).

To compare both alternatives, we make the following assumptions:

1. The firm has a project that requires the acquisition of a specific asset. The asset will be used for \( n \) periods, and its residual value at the end of the \( n \)th period is \( R \).
2. The user can purchase the asset at a price of \( C \) with borrowed funds. The borrowed funds are repaid with equal payments over \( n \) periods, and the debt is secured by the purchased asset. The interest rate on the debt is denoted as \( \gamma \), which reflects the risk of the project and the collateral provided by the firm.
3. The user can also lease the asset with equal lease payments over \( n \) periods. The implicit interest rate for calculating lease payment is also \( \gamma \).
4. The user’s tax rate is \( t_u \). The CCA rate for the particular asset is \( \theta \), and the loan payments or lease payments are made at the end of each period.
5. The financing market is competitive, and the lessors and lenders earn zero economic profit. We use lessor to represent both lessor and lender. The lessor’s tax rate is represented by \( t_l \).

The analysis of our model is detailed in the appendix. The main results are summarized below.

Result 1: The instalment payment for the loan in each period is not a function of the lessor’s tax rate.

Result 2: The instalment payment for the lease in each period is a decreasing function of the lessor’s tax rate.

Result 3: If the lessor and the firm have the same tax rate, then the firm is indifferent between leasing and financing a purchase of the needed asset.

Result 4: The firm will lease if its tax rate \( (t_u) \) is lower than the lessor’s tax rate \( (t_l) \).

Result 5: The benefit of leasing is an increasing function of the gap between \( t_u \) and \( t_l \).

---

21 We recognize that other reasons may affect the decision to buy or lease an asset. For example, when a firm acquires an asset, it may have to provide a significant proportion (perhaps up to 40 percent) of the value of the asset as an upfront cash down payment (see Joselito Gallardo, Leasing To Support Micro and Small Enterprises, Policy Research Working Paper no. 1857 (Washington, DC: World Bank, 1997)). Furthermore, the firm may have to provide collateral and may lack the credit history to obtain a loan, mostly in the case of assets that increase production levels. To avoid these constraints, small private firms may prefer leasing. In their theoretical model, Eisfeld and Rampini show that firms with credit constraints are more likely to enter into leases: Andrea L. Eisfeld and Adriano A. Rampini, “Leasing, Ability To Repossess, and Debt Capacity,” The Review of Financial Studies (forthcoming).
To analyze the decision to lease or purchase the asset, we examine two scenarios. First, assume that there is a single-period model (or equally, multiple periods with constant tax rates). If the highest corporate tax rate is denoted by $T$, then both the lessors’ and the firms’ tax rates range from 0 to $T$. Under a competitive financing market, the lease payment is a decreasing function of the lessor’s tax rate (result 2), and the benefit of leasing (compared with purchasing) is an increasing function of the gap between the tax rate of the firm and the lessor (result 5). This implies that all firms will lease from lessors having the highest tax rates, and only these lessors survive in the leasing market. In other words, firms lease from lessors whose tax rate is $T$ to minimize lease payments. Therefore, under this scenario and assuming that tax is the only consideration, because only lessors with the maximum tax rate will remain in the market, the firms are either indifferent between leasing the asset and purchasing it if their tax rate is also $T$ (result 3), or they always prefer leasing if their tax rate is lower than $T$ (result 4). Consequently, firms’ tax rates do not directly affect leasing decisions because a lessor’s tax rate will be at least as high as the firms’ tax rate. Similarly, the level of the interest rate does not directly affect firms’ leasing decisions because the benefit of leasing is non-negative at any interest level when lessors’ tax rates are higher than the firms’ tax rates. However, the size of the benefit of leasing is affected by the firms’ tax rate and interest rate, which may indirectly affect firms’ leasing decisions.\footnote{Firms’ leasing decisions are affected by other factors in addition to tax considerations. This article focuses on the tax-related issue, which can explain some causal relationship between the assets’ life and leasing decisions. However, the full leasing decision can be explained only if all relevant factors are considered, which is beyond the scope of this article.}

Second, assume that there is a multiperiod model where the lessor’s tax rate across periods is not necessarily constant. In this case, the lessor’s tax rate may not remain at $T$ in all periods due to fluctuations in the lessor’s profitability. Consequently, if the lessor’s tax rate could be lower than $T$ in some periods during the lease term, result 2 implies that the lease payments required by the lessor would be higher than the payment required under a constant tax rate $T$. In other words, because the lessor’s operation is not risk-free, there are extra costs that may be passed on to the firm if it leases an asset with a useful life greater than one period.

To gain further intuition, suppose that the lessor has a tax rate $T$ at the beginning of period 1 and has an asset with a multiperiod life available for leasing. If the lease term covers the life of the asset, then to calculate the lease payment required in each period, the lessor must consider the expected tax rate over all periods of the lease. More specifically, to obtain the expected return from the leased asset, the lessor cannot use the tax rate $T$ in the calculation to determine the lease payments because, in some periods, it is possible that the tax rate could be lower than $T$. This will lead to a higher lease payment in each period than the lease payment under a scenario where the tax rate is constant at $T$. To eliminate the uncertainty related to future tax rates for the lessor and to decrease the lease payments, the firm may prefer to sign a series of leases having only one period with a lessor whose tax rate is $T$ in that period.
Lessors may also engage in sophisticated transactions to maximize the tax-related benefits, such as in *The Queen v. Canada Trustco Mortgage Co.* case. However, related transaction and contracting costs may not be trivial, preventing such strategic behaviour. Furthermore, lessors who have assets with multiperiod lives on hand cannot afford to receive the minimum lease payments in only some periods if there is a possibility that their assets in some other periods are not leased when their tax rates go down.

Given a certain level of operational risk, the number of periods where the lessor’s future tax rate is lower than $T$ increases with the lease term. This implies that the de facto tax rate in the calculation of the lease payment is lower for assets with longer lives and, hence, the lease payments will be higher. Considering that firms with a tax rate higher than the de facto tax rate used by the lessor will not lease the assets (result 4), longer-lived assets will be leased less often than shorter-lived assets. Furthermore, if leased assets fall into the non-exempt category under the specified leasing property rules, the lease benefits resulting from tax savings could be further reduced because the assets’ useful lives are longer for a given CCA rate. As mentioned by Jog, the 1989 tax reform adversely affects the leases of equipment with CCA rates that are higher than their economic depreciation rates. This effect is greater if the assets’ useful lives are longer. The above analyses lead to the following hypothesis:

**Hypothesis:** The portion of leased assets to total assets held by a firm is a decreasing function of the expected useful lives of the assets.

**THE EMPIRICAL ANALYSIS**

**The Methodology**

We test the predictions of our analysis from the previous section of this article using data from a sample of Canadian publicly traded firms. We manually collect the information needed for the tests from firms’ annual reports posted on the SEDAR Web site.

---

23. 2005 DTC 5523 (SCC).

24. Note that the uncertainty in a firm’s future tax rate does not have a similar impact on leasing decisions as does the tax rate of the lessor. The lessor’s future tax rate can move in one direction only (it goes down from the current high level $T$): the expected tax rate is then lower and the correspondingly calculated lease payment is higher. A firm’s future tax rate can move in either direction, which results in a small, or no, change in the expected tax rate (that is, they may cancel out in expectation). As a result, the expected impact on the benefit of a lease is minimal.


26. The system for electronic document access and retrieval (SEDAR) is a Web site developed for Canadian securities administrators. All information filed under the requirements of the securities regulatory agencies in Canada is publicly available on this Web site (http://www.sedar.com).
The firms selected for analysis represent the TSX270 for the fiscal year 2005, allowing us to identify a broad sample of firms across most industries. From this sample, we eliminate financial institutions and real estate companies that are mostly involved in lease transactions as lessors. This results in a sample of 253 firms. We also eliminate natural resource companies (99 firms) and income trusts (32 trusts) because the model we developed does not apply to these two categories of firms. We lose an additional 11 observations due to missing data. The final sample is composed of 111 firms.

The model includes the discounted value of operating leases, deflated by total assets, as the dependent variable. However, future obligations under operating leases are not recognized in the body of the financial statements. Therefore, we need to determine the present value of the minimum lease payments to obtain the operating lease obligations as if they were recognized in the body of the financial statements. Therefore, we collect all available information to make this calculation from the notes to the financial statements.

Two basic assumptions are needed to calculate the discounted value of operating leases. First, we need a discount rate. As discussed in section 3065 of the Handbook of the Canadian Institute of Chartered Accountants, “the discount rate used by the lessee in determining the present value of minimum lease payments would be the lower of the lessee’s rate for incremental borrowing and the interest rate implicit in the lease, if practicable to determine.” As discussed by Imhoff, Lipe, and Wright, the discount rate should be the weighted average implicit rate for each portfolio of operating leases. However, this rate is not always available due to limited information provided in the notes. Therefore, Imhoff et al. discuss two alternative ways to determine the discount rate. The implicit rate on a capital lease can be determined on the basis of the information provided in the notes. Alternatively, on the basis of the information provided in the note on long-term debt, an average interest rate can be calculated. Given that the information needed to calculate the implicit interest rate on capital leases is almost never provided, we use the average interest rate. Therefore, the discount rate is defined as the average implicit rate on operating leases when it is provided; otherwise, we take the average interest rate on long-term debt.

---

27 The leasing activities of natural resource firms typically involve long-term rights to exploit a resource on a property rather than leasing amortizable capital assets. Income trusts are eliminated because the model deals with the tax consequences of leasing or buying an asset, and these firms do not pay income tax.

28 The missing information was either the absence of information on firms’ cost of capital that we could use to capitalize operating leases or other specific variables used in our tests.

29 Canadian Institute of Chartered Accountants, CICA Handbook (Toronto: CICA) (looseleaf), section 3065, paragraph 16.


31 Less than 25 percent of the firms disclosed the implicit rate in the notes to the financial statements.
The second assumption deals with the duration of cash flows. The Canadian accounting standards require firms to provide the future minimum lease payments for the next five years and the aggregate amount for the remaining years. Also consistent with Imhoff et al., we divide the “beyond five years” obligation by the amount of obligation in the fifth year to approximate the annual minimum lease payment in the years following the fifth year. We then discount the annual lease payment to obtain the discounted value of operating leases.

We use the following model to test our predictions:

\[
\text{Leases} = \beta_0 + \beta_1 \text{Useful\_life} + \beta_2 \text{HMTR} + \beta_3 \text{MMTR} + \beta_4 \text{Discount} \\
+ \beta_5 \text{Leverage} + \beta_6 \text{ROA} + \beta_7 \text{Working\_cap} + \beta_8 \text{CFO\_CL} + \beta_9 \text{Size} \\
+ \beta_{10} \text{Capital\_assets} + \beta_{11} \text{Market\_book} + \beta_{12} \text{Merchandising} \\
+ \beta_{13} \text{Manufacture} + e.
\]

We first use total leases deflated by total assets as the dependent variable because the model categorizes all leases as operating leases to be consistent with the tax treatment. However, because of the difference between the tax and accounting treatment, we also conduct the analysis excluding capital leases from the left-hand side. When operating leases are used on the left-hand side, we include the obligations under capital leases as an independent variable.\(^{32}\)

We include four categories of independent variables. First, we include variables to test the general predictions of our theoretical analysis. Recall that the theory predicts that firms are more likely to buy assets with longer useful lives. Because the useful life (identified as \text{Useful\_life} in the regression) of assets for operating leases is not disclosed in the notes to the financial statements, to proxy for the useful lives of unrecognized assets (under operating leases), we assume that the useful lives of the recognized assets in the balance sheet are highly correlated to the useful lives of those that are not recognized.\(^{33}\) On the basis of this assumption, we can proxy for the useful lives by taking the gross value of capital assets divided by the amortization expenses. However, several firms do not disclose the amortization expense or, when it is disclosed, firms often combine the amortization expense of tangible and intangible assets. To proxy for the useful life, we use capital expenditures instead of amortization expenses due to the limitations associated with the disclosure of the amortization expenses. To the extent that most firms maintain their production capacity (or a large component of their capital expenditures is to maintain their productive activities),

\(^{32}\) We believe that presenting the results for both total leases and operating leases provides stronger evidence in supporting the predictions of the model. We also attempted to examine the results using capital lease obligations as the dependent variable, but the number of observations was too small to obtain meaningful results.

\(^{33}\) There is a possibility that our proxy for \text{Useful\_life} is biased because it is based on an approximation using capital expenditures. Because the decision to lease or purchase is affected by the useful life of the asset, we probably overestimate the useful life of a leased asset. Although this bias cannot be avoided, its direction is against our predictions.
the ratio of the gross value of capital assets over annual capital expenditures should provide a reasonable proxy for the useful lives of the assets.\textsuperscript{34} Because the model predicts that buying the asset is more advantageous for those assets with longer useful lives, we expect a negative sign on this variable.\textsuperscript{35}

We also include the marginal tax rate in the regression. Following Klassen and Mawani,\textsuperscript{36} we calculate the marginal tax rate on the basis of estimated taxable income and whether or not the firm has operating loss carryforwards. The presence of loss carryforwards is determined from the notes to the financial statements. Taxable income is estimated as net income before taxes less the change in future tax liabilities from the balance sheet, grossed up by the statutory tax rate.\textsuperscript{37}

Using the operating loss carryforward and the estimated taxable income, we create a trichotomous variable defined as follows. If estimated taxable income is positive and the firm has no operating loss carryforward, then the firm is assumed to have a high marginal tax rate. If estimated taxable income is positive and the firm has an operating loss carryforward or if the firm has current losses but no loss carryforward, then the firm is assumed to have a moderate marginal tax rate. Finally, if the firm has current losses and a loss carryforward, then the firm is assumed to have a low marginal tax rate.\textsuperscript{38} To capture the marginal tax rate, two dummy variables are included in the regression. $HMTR$ takes the value of 1 if the firm is assumed to have a high marginal tax rate and 0 otherwise. $MMTR$ takes the value of 1 if the firm has a moderate marginal tax rate and the value of 0 otherwise. Firms with a low marginal tax rate are captured by the intercept.

We also include the discount rate ($Discount$) in the regression. As discussed above, the discount rate is defined as the average implicit rate on operating leases when it is provided; otherwise, we take the average interest rate on long-term debt. On the basis of the predictions of our model, we do not expect the coefficients on the two tax variables and on the discount rate variable to be significant.

\textsuperscript{34} The ratio of the gross value of capital assets divided by capital expenditure implies that firms mainly use straightline depreciation. Furthermore, it assumes that the residual value is not guaranteed or that it is small relative to the total value of the leased assets. In addition, firms’ capitalization policies will affect the numerator and may affect the proxy for the useful life of the assets.

\textsuperscript{35} The amount of capital expenditures invested by a firm can vary from year to year. To examine the robustness of our results, we used average capital expenditures over a two-year and a three-year period. The results are robust to these alternative specifications.


\textsuperscript{37} Assuming that firms pay income tax in Ontario, we use a statutory tax rate of 36 percent for 2005.

Second, we introduce two accounting variables: financial leverage (Leverage) and return on assets (ROA). Considering that operating leases are viewed as off-balance-sheet liabilities, we expect a positive association between the leverage ratio and the use of operating leases. The economic impact of operating leases versus buying the assets will be the same at the end of the useful lives of the assets. However, the timing of the expense recognition will differ. At the beginning of the useful life of the asset, net income will be lower when the firm acquires the asset because the combination of amortization and interest expense will be greater than the lease expense. Therefore, we expect that firms with a low level of profitability will prefer operating leases and, hence, we expect a negative sign on the variable ROA.

Third, we include two debt capacity variables. The first variable (Working_cap) is measured as working capital (current assets minus current liabilities) deflated by total assets. We expect a positive sign on this variable because operating leases are not recognized in the balance sheet and, hence, the amount of current liabilities is not increased by operating leases. The second variable is the cash flows from operations divided by current liabilities (CFO_CL). This variable captures the ability of the firm to generate enough cash flows from operations to meet its current obligations. Firms that do not have enough debt capacity to make an initial payment for the acquisition of an asset will likely enter into an operating lease agreement and, hence, we predict a negative sign on these variables.39

Fourth, we include several control variables. Leased assets may be directly linked to capital assets. That is, when capital assets increase, leased assets may also increase relative to total assets. To control for this potential effect, we include capital assets (Capital_assets) as a control variable. We predict a positive sign on the coefficient of this variable. We include the firm’s size (Size) to control for size-related factors such as the stability level of operation and extent of information asymmetry, defined as the natural logarithm of total assets. We have no prediction on the sign of this variable. We control for growth by including the ratio of market-to-book value of equity (Market_book).40 Growth firms are expected to acquire more assets and, hence, we expect a positive sign on this variable. Finally, we control for industry.

The Results

Table 1 provides some descriptive statistics on the variables used in the model, and table 2 provides the correlations of the variables. As indicated in table 1, unrecognized operating leases represent, on average, 9.8 percent of the value of total assets, while capital leases (recognized leases) account for less than 1 percent of the total assets. On average, firms in our sample are profitable, as indicated by the average ROA of 9.3 percent, and have a mean leverage value of 58.8 percent. The volatility in the leverage ratio is consistent with a similar fluctuation observed on the discount rate.

39 See Gallardo, supra note 21.
40 We obtain similar results when the growth in sales is used instead of the market-to-book ratio of equity.
TABLE 1  Descriptive Statistics (111 Observations)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>0.098</td>
<td>0.157</td>
<td>0.013</td>
<td>0.040</td>
<td>0.097</td>
</tr>
<tr>
<td>Useful_life</td>
<td>8.5</td>
<td>7.8</td>
<td>4.3</td>
<td>6.2</td>
<td>10.2</td>
</tr>
<tr>
<td>Discount</td>
<td>0.066</td>
<td>0.020</td>
<td>0.050</td>
<td>0.063</td>
<td>0.079</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.588</td>
<td>0.195</td>
<td>0.468</td>
<td>0.579</td>
<td>0.695</td>
</tr>
<tr>
<td>ROA</td>
<td>0.093</td>
<td>0.194</td>
<td>0.049</td>
<td>0.081</td>
<td>0.108</td>
</tr>
<tr>
<td>Working_cap</td>
<td>0.110</td>
<td>0.384</td>
<td>-0.010</td>
<td>0.095</td>
<td>0.197</td>
</tr>
<tr>
<td>CFO_CL</td>
<td>0.568</td>
<td>0.671</td>
<td>0.202</td>
<td>0.431</td>
<td>0.721</td>
</tr>
<tr>
<td>Capital_lease</td>
<td>0.006</td>
<td>0.017</td>
<td>0.000</td>
<td>0.000</td>
<td>0.013</td>
</tr>
<tr>
<td>Capital_assets</td>
<td>0.365</td>
<td>0.245</td>
<td>0.133</td>
<td>0.358</td>
<td>0.507</td>
</tr>
<tr>
<td>Market_book</td>
<td>2.722</td>
<td>2.587</td>
<td>1.534</td>
<td>2.123</td>
<td>2.970</td>
</tr>
<tr>
<td>Estimated tax rate</td>
<td>0.271</td>
<td>0.156</td>
<td>0.185</td>
<td>0.310</td>
<td>0.352</td>
</tr>
</tbody>
</table>

The variables are defined as follows:

Operating  discounted value of operating leases deflated by total assets.
Useful_life  estimated useful life of assets recognized as operating leases, calculated as the firm's capital assets divided by capital expenditures.
Discount  discount rate calculated as the average implicit rate on operating leases, when disclosed, or as the average interest rate calculated as interest expense divided by total debt.
Leverage  financial leverage calculated as total liabilities divided by total assets.
ROA  return on assets defined as operating income over total assets.
Working_cap  working capital (current assets minus current liabilities) deflated by total assets.
CFO_CL  cash flows from operations over current liabilities.
Size  the natural logarithm of total assets.
Capital_leases  obligations under capital lease deflated by total assets.
Capital_assets  capital assets deflated by total assets.
Estimated tax rate  income tax divided by income before tax.

Our proxy for useful life indicates an average value of 8.5 years with a standard deviation of 7.8 years. The average firm has a positive liquidity situation and exhibits a large volatility in the proportion of capital assets over total assets. Also, by using the TSX270, our sample is composed mainly of large Canadian firms.

Results of the regression are presented in table 3.41 The first regression uses total leases as the dependent variable and the second regression uses the discounted value of operating leases. The first set of independent variables is derived from the model developed in the previous section. Consistent with the model, the coefficient of the

41 The results are presented using ordinary least squares regressions. Similar conclusions hold when we use censored tobit methodology.
<table>
<thead>
<tr>
<th></th>
<th>Operating</th>
<th>Useful_life</th>
<th>Discount</th>
<th>Leverage</th>
<th>ROA</th>
<th>Working_cap</th>
<th>CFO_CL</th>
<th>Size</th>
<th>Capital_leases</th>
<th>Capital_assets</th>
<th>Market_book</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating</td>
<td>1.0000</td>
<td>-0.1980</td>
<td>-0.0334</td>
<td>0.2544</td>
<td>-0.0624</td>
<td>0.3096</td>
<td>-0.1072</td>
<td>-0.2103</td>
<td>0.1184</td>
<td>-0.0329</td>
<td>0.0123</td>
</tr>
<tr>
<td>Useful_life</td>
<td>1.0000</td>
<td>0.0020</td>
<td>0.0843</td>
<td>0.38</td>
<td>-0.0345</td>
<td>-0.0246</td>
<td>0.1181</td>
<td>0.1161</td>
<td>0.0995</td>
<td>0.5395</td>
<td>-0.1180</td>
</tr>
<tr>
<td>Discount</td>
<td>1.0000</td>
<td>0.1505</td>
<td>0.2548</td>
<td>0.12</td>
<td>0.0467</td>
<td>-0.0052</td>
<td>0.1418</td>
<td>0.1646</td>
<td>-0.0167</td>
<td>0.0542</td>
<td>0.0783</td>
</tr>
<tr>
<td>Leverage</td>
<td>1.0000</td>
<td>-0.0943</td>
<td>0.1145</td>
<td>0.32</td>
<td>-0.1721</td>
<td>0.4333</td>
<td>0.1028</td>
<td>0.2515</td>
<td>0.1494</td>
<td>-0.1199</td>
<td>0.0746</td>
</tr>
<tr>
<td>ROA</td>
<td>1.0000</td>
<td>-0.0148</td>
<td>0.3276</td>
<td>0.88</td>
<td>0.0683</td>
<td>0.0044</td>
<td>0.0614</td>
<td>0.0184</td>
<td>-0.1199</td>
<td>0.0783</td>
<td>0.0746</td>
</tr>
<tr>
<td>Working_cap</td>
<td>1.0000</td>
<td>-0.0459</td>
<td>-0.1645</td>
<td>0.63</td>
<td>-0.0350</td>
<td>-0.1566</td>
<td>0.0958</td>
<td>0.52</td>
<td>0.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFO_CL</td>
<td>1.0000</td>
<td>0.1539</td>
<td>-0.0191</td>
<td>0.11</td>
<td>0.1477</td>
<td>-0.2424</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>1.0000</td>
<td>0.0536</td>
<td>0.2980</td>
<td>0.57</td>
<td>-0.1127</td>
<td>(0.24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital_leases</td>
<td>1.0000</td>
<td>0.0871</td>
<td>-0.2231</td>
<td>0.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital_assets</td>
<td>1.0000</td>
<td>-0.0131</td>
<td>(0.89)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Market_book</td>
<td></td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: See table 1 for definitions of the variables.
### TABLE 3  Regression Analysis (Regression 1 Uses Total Leases as the Dependent Variable and Regression 2 Uses Operating Leases as the Dependent Variable)

<table>
<thead>
<tr>
<th>Predictions (model)</th>
<th>Regression 1</th>
<th>Regression 2(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expected sign</td>
<td>Coefficient</td>
</tr>
<tr>
<td><strong>Useful_life</strong></td>
<td>-</td>
<td>-0.0047</td>
</tr>
<tr>
<td><strong>HMTR</strong></td>
<td>?</td>
<td>-0.0305</td>
</tr>
<tr>
<td><strong>MMTR</strong></td>
<td>?</td>
<td>-0.0070</td>
</tr>
<tr>
<td><strong>Discount</strong></td>
<td>?</td>
<td>-0.3424</td>
</tr>
<tr>
<td><strong>Accounting variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leverage</strong></td>
<td>+</td>
<td>0.2512</td>
</tr>
<tr>
<td><strong>ROA</strong></td>
<td>-</td>
<td>-0.0708</td>
</tr>
<tr>
<td><strong>Debt capacity variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Working_cap</strong></td>
<td>+</td>
<td>0.0768</td>
</tr>
<tr>
<td><strong>CFO_CL</strong></td>
<td>-</td>
<td>0.0020</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>?</td>
<td>-0.0461</td>
</tr>
<tr>
<td><strong>Capital_assets</strong></td>
<td>+</td>
<td>0.0974</td>
</tr>
<tr>
<td><strong>Capital_leases</strong></td>
<td>na/+</td>
<td></td>
</tr>
<tr>
<td><strong>Market_book</strong></td>
<td>+</td>
<td>-0.0055</td>
</tr>
<tr>
<td><strong>Merchandising</strong></td>
<td>?</td>
<td>0.1923</td>
</tr>
<tr>
<td><strong>Manufacture</strong></td>
<td>?</td>
<td>-0.0292</td>
</tr>
<tr>
<td><strong>Intercept</strong></td>
<td>?</td>
<td>0.6754</td>
</tr>
</tbody>
</table>

| No. of observations . . . | 111       | 107       |
| \(F\)-value . . . . . . . | 6.44      | 6.97      |
| Adjusted \(R^2\) . . . . . . | 39.14\%  | 43.19\%  |

The variables are defined as follows:

- **HMTR**: a dummy variable that equals 1 when the firm has a high marginal tax rate and 0 otherwise.
- **MMTR**: a dummy variable that equals 1 when the firm has a moderate marginal tax rate and 0 otherwise.
- **Merchandising**: a dummy variable that equals 1 if the firm is a merchandising company (Standard Industrial Classification (SIC) code between 5000 and 6000) and 0 otherwise.
- **Manufacture**: a dummy variable that equals 1 if the firm is a manufacturer (SIC code between 2000 and 4000) and 0 otherwise.

\(^a\) Four firms do not have operating leases in our final sample.
\(^b\) All tests with predicted signs are of one-sided null hypotheses. The critical values for one-sided tests are 1.28, 1.64, and 2.33 for 10 percent, 5 percent, and 1 percent tests, respectively.
\(^c\) Significantly different from 0 at the 1 percent level.
\(^d\) Significantly different from 0 at the 5 percent level.
\(^e\) Significantly different from 0 at the 10 percent level.
variable *Useful_life* is negative, as expected, and significant at the 1 percent level in both regressions. Therefore, assets with longer useful lives are less likely to be leased. Our results are consistent with our model because the coefficient on the discount rate (*Discount*) and the coefficients on the two tax variables (*HMTR* and *MMTR*) are insignificant in both regressions.

The signs on the coefficients of the accounting variables are consistent with our prediction, but only one is significant. That is, the coefficient on financial leverage (*Leverage*) is positive and significant at the 1 percent level in both regressions. This suggests that firms are more likely to lease assets as their leverage ratio increases. The coefficient of the variable *ROA* is negative, as expected, but it is insignificant.

Regarding the debt capacity variables, the coefficient of *Working_cap* is positive, as expected, and significant at the 1 percent level in both regressions. This result is indicative of lower current liabilities when the obligation is not recognized in the financial statements. The second liquidity variable, *CFO_CL*, has a negative coefficient, as expected, but it is insignificant. For the control variables, we observe a negative association between the size of the lease obligation and firm size and a positive association between the size of the lease obligation and the value of capital assets. The growth variable, market-to-book value of equity, is insignificant. Finally, one of the industry dummy variables, *Merchandising*, is significant because retailers mainly lease their stores and other equipment. In the second regression, the coefficient on *Capital_leases* is significant at 5 percent. The adjusted $R^2$ of each regression is 39.14 percent and 43.19 percent respectively.

We also conduct several robustness analyses. First, we include the current ratio instead of the variable *Working_cap*. Second, we use the return on equity and profit margin instead of the return on assets. Third, we use the average tax rate, defined as tax over income before taxes, instead of the marginal tax rate. Fourth, we replace the market-to-book value of equity variable by the growth in sales variable. The results of these additional empirical analyses are unaffected by these changes in specifications (the results are not presented in table 3 for the sake of brevity).

**CONCLUSION**

In this article, we develop a theoretical analysis of the tax consequences of buying or leasing an asset. Our study has both theoretical and practical implications. Our study shows that uncertainty in the lessor’s future tax rate is an important determinant in firms’ leasing or buying decisions. We develop a model that demonstrates that assets with shorter useful lives are more likely to be leased than assets with longer useful lives. More specifically, we show that, in a competitive financing market, lease payments are a decreasing function of lessors’ tax rates. As a consequence, because lessors’ tax rates are less likely to remain at the highest level during a longer horizon, higher leasing costs and less leasing activities are expected as the expected useful life of the asset increases. Therefore, we predict that assets with shorter expected useful lives are more likely to be leased.

We then empirically test the predictions of our model using the TSX270 as our sample. Consistent with our model, the useful life of the asset is negatively associated
with the proportion of leases held by firms in our sample. The results also indicate that the proportion of leases is positively associated with financial leverage, working capital, and the proportion of capital assets. A negative correlation is observed between the presence of leases and firm size. Our theoretical analysis and empirical tests can help practitioners to provide better advice to their clients for making financing decisions related to capital assets.

We would like to point out that our sample from the TSX270 consists of major Canadian firms. Therefore, it is not clear whether our results can be generalized to smaller firms. Because the comparison of large and small firms is beyond the scope of this article, it is a potential future research topic. We use the depreciation expenses and the capital assets to estimate the useful life of leased assets. This proxy has some weaknesses. First, it may not be the case that purchased and leased assets have the same useful lives. Second, it is possible that the useful life might be a determinant of leasing decisions for non-tax reasons, which is not explored in this article. Therefore, a future study could survey companies to gather information on the type of leased assets and the useful lives. Other future research could include both lessees and lessors in the analysis. Further, due to the low tax rate for pension funds, a study of the relationship between pension funds and leases would be interesting.

APPENDIX

Basic Assumptions

1. The firm has a project that requires the acquisition of a specific asset. The asset will be used for \( n \) periods, and its residual value at the end of the \( n \)th period is \( R \).
2. The user can purchase the asset at a price of \( C \) with borrowed funds. The borrowed funds are repaid with equal payments over \( n \) periods, and the debt is secured by the purchased asset. The interest rate on the debt is denoted as \( \gamma \), which reflects the risk of the project and the collateral provided by the firm. Therefore, \( \gamma \) is the pre-tax discount rate.
3. The user can also lease the asset with equal lease payments over \( n \) periods. The implicit interest rate for calculating lease payment is also \( \gamma \).
4. The user’s tax rate is \( t_u \). The CCA rate for the particular asset is \( \theta \), and the loan payments or lease payments are made at the end of each period.
5. The financing market is competitive and the lessors and lenders earn zero economic profit. The lessor’s tax rate is \( t_l \).

Interest on a Loan

Assuming that the equal payment each period is denoted by \( P \), then the interest at the end of each period is:

First period: \( C\gamma \);
Second period: \( (C(1 + \gamma) - P)\gamma \);
Third period: \( (C(1 + \gamma)^2 - P(1 + \gamma) - P)\gamma \);
Fourth period: \((C(1 + \gamma)^3 - P(1 + \gamma)^2 - P(1 + \gamma) - P)\gamma;\)

\[
\ldots
\]

\(n\)th period: \((C(1 + \gamma)^{n-1} - P(1 + \gamma)^{n-2} - \ldots - P(1 + \gamma) - P)\gamma.\)

Let \(IE_k\) be the interest paid by the user at the end of period \(k\), and let \(t\) be the tax rate \((t = t_l\) for the lessor and \(t = t_u\) for the user). Therefore, the present value of the interest is:

\[
PV (The\ interest) = \frac{IE_1}{(1 + \gamma(1-t))} + \frac{IE_2}{(1 + \gamma(1-t))^2} + \frac{IE_3}{(1 + \gamma(1-t))^3} + \ldots + \frac{IE_n}{(1 + \gamma(1-t))^n}
\]

\[
= \gamma\left[\frac{C}{1 + \gamma(1-t)} + \sum_{k=2}^{n} \frac{(C(1 + \gamma)^{k-1} - P\sum_{j=0}^{k-2}(1 + \gamma)^j)}{(1 + \gamma(1-t))^k}\right]
\]

\[
= \frac{(1 + \gamma)^n}{t} - P\frac{(1 + \gamma)^n}{\gamma(1-t)} - C\frac{(1 + \gamma)^n}{(1 + \gamma(1-t))^n} - 1
\]

(1).

Then the present value of a loan after tax for the lender (value of \(t\) is \(t_l\)) is:

\[
PV(Loan, t = t_l) = \frac{1 - (1 + \gamma(1-t))^{-n}}{\gamma(1-t)} - \frac{C(1 + \gamma)^n}{(1 + \gamma(1-t))^n} - 1
\]

\[
+ P\frac{(1 + \gamma)^n}{\gamma(1-t)} - C\frac{(1 + \gamma)^n}{(1 + \gamma(1-t))^n} - \frac{1}{\gamma(1-t)}
\]

(2).

Because the financing market is competitive (basic assumption 5), then the lessor makes the expected return and, hence, \(PV(Loan, t = t_l) = C\) or

\[
P = \frac{C\gamma(1 + \gamma)^n}{(1 + \gamma)^n - 1}
\]

(3).

Result 1: The instalment payment for the loan in each period is not a function of the lessor’s tax rate.
The Tax Shield (CCA) from an Owned Asset

The tax impact of the CCA is obtained as follows. The present value of the tax shield at the beginning of period one is:

First period: \( CCA_1 = \frac{C\theta}{2} \),
\( UCC_1 = C - CCA_1 = C(1 - \frac{\theta}{2}) \),

where \( UCC \) represents the undepreciated capital cost. Applying the same logic to the following periods gives:

Second period: \( CCA_2 = UCC_1 \theta = C(1 - \frac{\theta}{2}) \theta \),
\( UCC_2 = UCC_1 - CCA_2 = C(1 - \frac{\theta}{2})(1 - \theta) \);

Third period: \( CCA_3 = UCC_2 \theta = C(1 - \frac{\theta}{2})(1 - \theta)^2 \),
\( UCC_3 = UCC_2 - CCA_3 = C(1 - \frac{\theta}{2})(1 - \theta)^3 \);

Fourth period: \( CCA_4 = UCC_3 \theta = C(1 - \frac{\theta}{2})(1 - \theta)^3 \theta \),
\( UCC_4 = UCC_3 - CCA_4 = C(1 - \frac{\theta}{2})(1 - \theta)^4 \);

\[ \ldots \]

nth period: \( CCA_n = UCC_{n-1} \theta = C(1 - \frac{\theta}{2})(1 - \theta)^{n-2} \theta \),
\( UCC_n = UCC_{n-1} - CCA_n = C(1 - \frac{\theta}{2})(1 - \theta)^{n-1} \).

The present value of the tax shield at time zero is:

\[
Pv(Taxshield \ of \ owning \ the \ asset) = t \left( \frac{CCA_1}{1 + \gamma(1-t)} + \frac{CCA_2}{(1 + \gamma(1-t))^2} + \frac{CCA_3}{(1 + \gamma(1-t))^3} + \ldots + \frac{CCA_n}{(1 + \gamma(1-t))^n} \right) + \left( \frac{UCC_n - R}{(1 + \gamma(1-t))^n} \right)
\]

\[= Ct \left( \frac{1}{2(1 + \gamma(1-t))} + \frac{1 - \frac{\theta}{\gamma(1-t)}}{(1 + \gamma(1-t))^2} + \frac{(1 - \theta)(1 - \theta)^{n-1}}{(1 + \gamma(1-t))^n} \right) \right) + \frac{C(1 - \frac{\theta}{\gamma(1-t)})^{n-1}(1 - \theta)^n - R}{(1 + \gamma(1-t))^n} \]

\[= Ct \frac{(\gamma(1-t) + 2\theta)}{2(1 + \gamma(1-t))(\gamma(1-t) + \theta)} + Ct \frac{\gamma(1-t)(1 - \frac{\theta}{\gamma(1-t)})(1 - \theta)^{n-1}}{(\gamma(1-t) + \theta)(1 + \gamma(1-t))^n} - \frac{R(1 - \theta)^n}{(1 + \gamma(1-t))^n} \]  (4).

Present Value of the Lease After Tax for the Lessor

\[
Pv(Lease, t = t_i) = L \frac{(1 - \gamma(1-t))^-n}{\gamma} + Ct \frac{(\gamma(1-t) + 2\theta)}{2(1 + \gamma(1-t))(\gamma(1-t) + \theta)}
\]

\[+ Ct \frac{\gamma(1-t)(1 - \frac{\theta}{\gamma(1-t)})(1 - \theta)^{n-1}}{(\gamma(1-t) + \theta)(1 + \gamma(1-t))^n} + \frac{R(1 - \theta)^n}{(1 + \gamma(1-t))^n} \]  (5).
Let $L$ be the lease payment for each period. Because the financing market is assumed to be competitive, then $PV(\text{Lease, } t = t_i) = C$ or

$$L(t = t_i) = \frac{C - Ct}{2(1 + \gamma(1-i))(\gamma(1-t) + \theta)} - \frac{Ct}{2(1 + \gamma(1-i))(\gamma(1-t) + \theta)} - \frac{\gamma(1-t)(1-\theta)(1-\theta)^{n-1}}{(1+\gamma(1-i))^n} - \frac{R(1-t)}{\gamma}$$

(6).

Result 2: The instalment payment for the lease in each period is a decreasing function of the lessor’s tax rate. Result 2 is a direct conclusion that the lessor’s market is competitive and that the present value of the tax shield is an increasing function of the lessor’s tax rate.

The Costs of Financing a Purchase Versus Leasing the Asset for the User

$$PV(\text{Cost of owning, } t = t_u) = P \frac{1 - (1+\gamma(1-i))^n}{\gamma(1-t)} - Ct \frac{(1+\gamma)^n}{(1+\gamma(1-t))^n} - \frac{1}{\gamma}$$

$$+ Pt \frac{1}{(1+\gamma(1-t))^n} - \frac{1}{\gamma} = \frac{1}{1+\gamma(1-t)} - \frac{1}{1+\gamma(1-t)}$$

$$- Ct \frac{(\gamma(1-t) + 2\theta)}{2(1+\gamma(1-t))(\gamma(1-t) + \theta)} - Ct \frac{\gamma(1-t)(1-\theta)(1-\theta)^{n-1}}{(1+\gamma(1-i))^n} - \frac{R(1-t)}{\gamma}$$

(7).

$$PV(\text{Cost of leasing, } t = t_u) = L \frac{1 - (1+\gamma(1-t))^n}{\gamma}$$

(8).

Result 3: If the tax rates of the user and the lessor are equal ($t_u = t_l$), then the present value of leasing or purchasing the asset is the same ($PV(\text{Cost of owning}) = PV(\text{Cost of leasing})$), and the user is indifferent between buying and purchasing the asset (directly from equations 2, 3, and 6).

Result 4: The user will lease the asset if its tax rate is lower than the lessor’s tax rate (that is, if $t_u > t_l$ then $PV(\text{Cost of owning}) < PV(\text{Cost of leasing})$) and vice versa (from result 2 and result 3).

Result 5: The benefit of leasing is an increasing function of the gap between $t_u$ and $t_l$ (from result 2 and result 4).