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Lease Valuation When Taxable Earnings Are a Scarce Resource

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ABSTRACT

In this paper, we examine leasing as a tax-arbitrage instrument. Analysis of a sample of UK leases presented in this paper suggests that lessors earn large positive NPVs. Our theoretical model seeks to explain these positive NPVs in terms of a market price for a scarce resource that we identify as scarce taxable earnings. Using these prices, the model permits a lessor to determine whether the profitability of a proposed set of lease contracts can be improved by writing a different set of contracts that makes better use of the lessor's taxable earnings. There may be two reasons why an initial portfolio of contracts may be suboptimal. Either there may be clienteles or the leasing market may be inefficient. Subsequently, we discuss reasons why the leasing market may be characterized by clienteles, and, using two different samples of leases, we test whether the leasing market is segmented and efficient.

IN THIS PAPER, WE examine leasing as a tax-arbitrage instrument. With asymmetrical tax positions between lessors and lessees, there will be positive net present values (NPVs) to lease transactions. (See Myers, Dill, and Bautista [21].) Analysis of a sample of United Kingdom (UK) leases presented in this paper suggests that lessors earn large positive NPVs. Our theoretical model seeks to explain these positive NPVs in terms of a market price for a scarce resource that we identify as scarce taxable earnings.

There are two implications of our model, one for financial intermediaries that act as lessors and the other for financial economists interested in the leasing market. The model permits a lessor to determine whether the profitability of a proposed set of lease contracts can be improved upon by writing a different set of contracts that makes better use of the lessor's taxable earnings. There may be two reasons why an initial portfolio of contracts that a lessor is about to write may be suboptimal. Either there may be clienteles (because the leasing market

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is segmented) or the leasing market may be inefficient. Consequently, in the second part of the paper, we discuss reasons why the leasing market may be characterized by clienteles, and, using two different samples of leases, we test whether the leasing market is segmented and efficient for the period covered by our data.

The approach taken in this paper permits us to reconcile two conflicting views: (a) that, in a competitive market, lease contracts should provide only a fair rate of return to the lessor and (b) the empirical evidence that lessors have earned significant positive net present values as measured by the Myers, Dill, and Bautista method.[1] Our theory explains the apparent positive NPVs as the reward obtained for using scarce taxable earnings to shelter the excess tax deductions of lessees via lease contracts. This reward takes the form of lower tax liabilities (in present-value terms) for the lessor and therefore a lower effective tax rate. Although the model is confined to the perspective of the lessor (i.e., those companies with taxable earnings), the principles may be carried over to the lessee.[2]

The paper also illuminates the more general literature on tax arbitrage. For example, Cooper and Franks [2] discuss the problem of valuing a project when there are tax interactions between projects; however, they do not provide any method for estimating market prices for their tax-motivated transactions. This paper suggests an approach for estimating such prices and provides empirical evidence as to the robustness of those prices to a given set of transactions.

In Section I of this paper, we discuss the empirical evidence that suggests that taxable earnings were scarce in the UK for the period of the early 1980s, which is the period of our data. We also provide some numerical examples to illustrate our valuation approach to a lease. In Section II, we describe our model for determining the optimal set of lease contracts for a lessor to write and for pricing taxable earnings. In Section III, we describe the conditions required for a competitive and integrated leasing market, and we show how violations of those conditions may produce clienteles. In Section IV, we describe two samples of leases, one a set of quotations and the other a set of leases written by a single lessor, and we report in Section V the results of our tests which suggest that the market shows signs of inefficiency and segmentation. Finally, in Section VI, we provide a summary.

[1] Miller and Upton [19] and Lewellen, Long, and McConnell [14] have argued the former view. Edwards and Mayer [8] in the UK and McGugen and Caves [17], Sorenson and Johnson [26], and Crawford, Harper, and McConnell [5] in the US have provided empirical evidence of positive NPVs.

[2] It is more complex to consider the position of lessees since, in practice, they face a variety of different forecast periods of non-taxpaying and, therefore, different effective tax rates. Without frictions, arbitrage opportunities would drive all lessees to a single effective tax rate. The fact that we observe very different effective rates (see Higson [11]) suggests that there are significant frictions (such as quantity restrictions on the assets that can be employed and, therefore, the amount of leasing that can be done). Given different effective tax rates, the equilibrium lease rate can be related to a lessee, with a particular forecast period of non-taxpaying. Potential lessees with shorter perspective periods of tax exhaustion will not necessarily have an incentive to enter the market. Conversely, those facing longer periods of tax exhaustion will earn a surplus. Since our lessor model assumes a single tax rate for all lessors, it should be apparent that to model the lessee position would require a more complex set of assumptions.

I. Valuing Taxable Earnings and Excess Tax Deductions

In this paper, we assume that taxable earnings are scarce in the economy and that, as a result, some or all of the tax benefits of leasing accrue to the lessor, which is the taxpaying company. In a competitive and frictionless market, when the supply of taxable earnings available for tax arbitrage exceeds the aggregate supply of excess tax deductions, we might expect all the benefits of tax arbitrage to accrue to the non-taxpaying lessee companies. Conversely, if the aggregate supply of taxable earnings is less than the aggregate supply of excess tax deductions, all the benefits should accrue to taxpaying lessor companies.[3] In this state, no corporate taxes will be paid. With frictions, it is entirely possible that some companies may pay corporate taxes, but taxable earnings may remain scarce. For example, companies that have low taxable earnings or that move in and out of taxpaying may find it too costly to act as a lessor (or engage in any other form of tax arbitrage). Since there is considerable uncertainty about the size of a company's taxable earnings until the end of the financial year, companies may be conservative in how much taxable earnings they make available for tax arbitrage (or how much costly tax shields they purchase). Frictions or inefficiencies may produce gains for both parties.

There is now a great deal of evidence to suggest that tax exhaustion (i.e., where companies have excess tax deductions) has been an important feature of the corporate tax systems in both the UK and the US. Empirical evidence by Devereux and Mayer [7] and Higson [11] suggests that, during the period 1981 to 1983, more than half of UK publicly traded corporations had excess tax deductions and, therefore, can be described as tax exhausted. Other evidence in the US reported by Cordes and Sheffrin [3] and DeAngelo and Masulis [6] suggests that one third of corporations could be classified as persistent nonpayers of corporation tax. The Bank of England [1] stated in 1980, "The growing incidence of tax exhaustion partly reflected the increase in generosity of first year capital allowances (i.e., 100% first year tax depreciation) . . ., and partly a general decline in profitability. These factors meant that leasing became an increasingly attractive form of finance for a growing number of companies" (p. 305). The UK Government's report on Corporation Tax [4] revealed that, between 1972 and 1982, thirty billion pounds of tax losses had accumulated and they were increasing at a rate of five billion pounds each year. The report goes on to suggest that excess tax deductions exceed taxable profits when it claims that "the cost to the Exchequer of converting allowances and reliefs into outright grants . . . would exceed the corporation tax yield" (p. 94). The report concludes that one third of UK corporations "never" pay corporation tax. As a result, as Mayer [15] puts it, "a trade in predicted taxable capacity can thus be expected to develop and this provides the motivation behind the leasing of capital goods between firms" (p. 287).[4] This evidence of scarcity is consistent with the two

[3] When there is an excess of tax shields relative to the amount of corporate tax liabilities, then the market price of the tax shields should approach zero so that the taxpaying purchasers of the tax shields (i.e., the lessors) will capture the entire tax benefit.

[4] In this paper, financial leases are entirely motivated by tax arbitrage. However, there are other reasons to lease; for example, producers of assets may use leasing as a marketing tool. However, such

samples of lease quotations and transactions analyzed in this paper, where lessors are shown to have earned large positive NPVs.

Before developing our model formally in Section III, we describe some numerical examples to illustrate (a) how we value the cash flows of a lease, (b) the way in which a lease affects taxable earnings, and (c) how the value of those earnings can be incorporated into the leasing analysis.

In our model, the value of each lease to a lessor has two attributes: the NPV of the after-tax cash flows of the lease and the value of the taxable earnings displaced by the lease. The difference between these two values we refer to as a lease's adjusted present value (APV). All leases with a positive NPV are profitable to undertake, but those leases with a positive NPV and a negative APV are using their taxable earnings less efficiently than other leases; as a result, they should not be part of the lessor's optimum portfolio of lease contracts.

Table I provides a conventional net present value for a lease, using the method of Myers, Dill, and Bautista (MDB), which discounts after-tax cash flows at the after-tax interest rate on comparable debt.[5] We have assumed a pretax interest rate of ten percent and a corporate tax rate of forty-five percent. For simplicity only, we have assumed that tax payments are made at the instant income is received and that tax benefits are received at the instant payments are made. The leased asset costs \$1000 and qualifies for a nine percent investment tax credit (worth \$90). Tax depreciation is straight line over five years on ninety-five percent of the asset's cost. Finally, the lease rentals are five annual payments (in advance) of \$239.82. The level of lease rentals has been fixed on the basis that the lessee is permanently tax exhausted and that all the benefits of the tax

Table I

Value of Lease to a Lessor: Conventional NPV

Year	Purchase Cost	Depreciation Tax Saving	Tax Credit	Rentals	Tax on Rentals	Net Cash Flows	Amount of Debt Supported by Lease (PV of Outstanding Cash Flows)[a]
0	−1000	85.5	90	239.82	−107.92	−692.60	762.02
1		85.5		239.82	−107.92	217.40	586.53
2		85.5		239.82	−107.92	217.40	401.39
3		85.5		239.82	−107.92	217.40	206.07
4		85.5		239.82	−107.92	217.40	

NPV at 5.5 percent = 69.42.

[a] For example, in year zero, the lease can support debt totalling

$$762.02 = \sum_{t=1}^{4} \frac{217.40}{(1 + 0.055)^t}$$

The assumption here is that a lease displaces debt on a dollar-for-dollar basis. (See Myers, Dill, and Bautista and Franks and Hodges for a discussion of this point.)

producers do not appear to dominate or greatly influence the tax-based leasing market in the UK. If such producers are not taxpaying (because they have excess tax deductions), acting as a lessor would be very costly if lease rates were sufficiently high to provide positive NPVs to lessees.

[5] See Myers, Dill, and Bautista and Franks and Hodges for an explanation of comparable debt.

arbitrage accrue to the lessor. As a result, the NPV of the lease versus purchase transaction is zero to the lessee.[6] The lessor's net present value of $69.42 can be obtained simply by discounting the "Net Cash Flows" at the after-tax rate of five and a half percent. The final column shows the present value of the remaining net cash flows at each date, and this represents the time profile of the debt the lease will support. A simple proof that this is the case is given in Franks and Hodges [10].

Table II shows the effect of the lease transaction on the lessor's taxable earnings in each year. The value of these changes is a function of the corporate tax rate and the cost of purchasing excess tax deductions from the lessee via the lease contract. In column 2 of Table II, tax depreciation reduces taxable earnings by $190 each year, while the tax credit reduces first-year taxable earnings by $200. In column 4, rentals increase taxable income, while interest charges in column 5 reduce it. In column 6, we show the total change in the lessor's taxable earnings generated by the lease. Reductions in taxable earnings will reduce corporate tax payments; however, such reductions may have a cost in the form of a payment to the lessee for supplying the excess tax deductions. In column 7, the value of a dollar of taxable earnings is shown as simply the corporate tax rate *minus* the cost of purchasing a dollar of excess tax deductions. The maximum reduction in taxes from sheltering a dollar of excess tax deductions is τ. However, if the gains from tax asymmetry are shared with the lessee (via adjustments in the rental schedule), there will be a cost c to the lessor per dollar of excess tax deductions. Thus, the term "the value of taxable earnings" refers to the present value of $(\tau - c)$ and measures the extent to which a dollar of taxable earnings enables a present-value saving to be made in future tax liabilities. It should be clear that τ is the upper bound on the value of a dollar of taxable earnings since this is the maximum saving from sheltering a dollar of excess tax deductions. We have provided a numerical example in footnote 7 where the costs c of excess tax deductions are positive.[7] The last column of Table II provides the dollar value of the changes in taxable earnings, which, when discounted at the lending rate of ten percent, provides a value of $69.42.[8] Thus, the NPV of the cash flows of the

[6]
$$\text{Purchase Cost} - \text{Present Values of Lease Payments} = 0.$$
$$1000 - \sum_{t=0}^{4} \frac{L}{1.1^t} = 0.$$

Solving for the equal annual lease payment, $L = 239.82$.

[7] Let us assume that the lessee is permanently non-taxpaying and that the benefits of tax arbitrage are shared between lessor and lessee. The value of the tax arbitrage for the lessor is now the nominal tax rate (0.45) minus the cost of buying a dollar of excess tax deductions (say, 0.353 dollars); thus, the benefit to the lessor is $0.0978 for every dollar of tax deductions sheltered by the lease. The present value of the benefit, if it occurs one year hence, is $0.088 discounted at ten percent. This value of 0.088 can be described as today's price for a dollar of taxable earnings.

Stickney, Weil, and Wolfson [27] suggest that many commerical banks in the US took the role as lessor in safe-harbor leases transacted in 1981. They estimate that one lessor paid roughly seventy cents on the dollar for over $1.5 billion in tax benefits.

[8] Hodges [12] points out that we can think of the case where taxable earnings are scarce (and all the gains from tax arbitrage accrue to taxpaying companies) as being a Modigliani and Miller [20] after-tax equilibrium. Conversely, where there is an excess of taxable earnings (and all the gains accrue to non-taxpaying companies), we could describe it as a Miller [18] equilibrium. A third

Table II

Value of Taxable Earnings Used by the Lease Assuming That All Benefits of Tax Arbitrage Accrue to Lessor

(1) Year	(2) Tax Depreciation[a]	(3) Tax Credit (Grossed Up)[b]	(4) Rentals	(5) Interest on Debt Supported by the Lease[c]	(6) Total Change in Taxable Earnings	(7) Unit Tax Saving (45%) − Cost of Dollar of Tax Deduction	(8) Value of Changes in Taxable Earnings
0	190	200	−239.82	—	150.18	0.45 − 0.00	67.58
1	190		−239.82	76.20	26.38	0.45 − 0.00	11.87
2	190		−239.82	58.65	8.83	0.45 − 0.00	3.97
3	190		−239.82	40.14	−9.68	0.45 − 0.00	−4.36
4	190		−239.82	20.16	−29.21	0.45 − 0.00	−13.14

PV of earnings changes at 10% = 69.2.
APV of lease = 0.

[a] Depreciation is 950/5 per year.

[b] Tax credit for first year grossed up is $\frac{90}{1 - 0.45} = 200$.

[c] Imputed interest at ten percent calculated on the loan balance outstanding, as it appears in the final column in Table 1.

lease (to the lessor) as measured by the MDB method in Table I is equal to, and therefore completely explained by, the value of the taxable earnings used by the lease; the difference is referred to as the APV of the lease.

Net Present Value of the Cash Flows of the Lease	−	Value of Changes in Taxable Earnings	=	Adjusted Present Value of Lease.
69.42	−	69.42	=	0.

In our example, the APV of the lease is zero by construction. We can expect that, in a competitive leasing market and in the absence of clienteles, the APV of each lease to a lessor will be zero. We explain in Section IV that a nonzero APV can be caused by a segmented leasing market (giving rise to clienteles) and by inefficiencies. In Sections V and VI, we show that some leases transacted in the early 1980s did have nonzero APVs to lessors.

We have discussed an upper bound on the value of taxable earnings; the lower bound on a dollar of taxable earnings is zero. This lower bound prevails when all the gains from tax asymmetry accrue to the lessee ($\tau = c$) and therefore when the present value of the lessor's tax liabilities are not reduced by the lease transaction. There cannot be a negative price for taxable earnings since a lessor would find the present value of its tax liabilities increased as a result of the lease. When the lower bound prevails, there will be no tax incentive for the lessor to lease. (There will be one for the lessee.)

II. A Model for Determining Optimal Lease Choice and for Pricing Taxable Earnings

In the previous section, we described an example where the NPV of the cash flows of a lease exactly equalled the PV of changes in taxable earnings affected by the lease; as a result, the APV of the lease was zero. If the APVs of some of the individual leases in an initial portfolio that is about to be chosen are nonzero, the portfolio can be improved by changing its composition. Providing we can specify a set of initial lease contracts, a model can be developed that will provide an optimal (i.e., least-cost) portfolio of lease contracts by using linear programming. The NPV of each lease and its effects on taxable earnings are used as the main inputs to this model. The individual leases in the portfolio can generally differ on the basis of length of the lease's life, the rate of tax depreciation, and the availability of the investment tax credit. The lessor is assumed to be taxpaying in all periods, and all lessors are assumed to pay the same marginal corporate tax rate.[9] All leases are financial and therefore are full-payout leases and are free

equilibrium, described by DeAngelo and Masulis [6], would be where future tax positions are uncertain and depend on the amount of borrowing that companies undertake. As we might expect, investors' required rates of return and discount rates for lease transactions will depend upon the particular equilibrium. Our numerical example in Tables I and II assumes an MM equilibrium.

[9] This assumption requires than an individual lessor is prevented from contracting a set of leases that places it in a tax-loss position in any state of the world. Such an assumption does not require that taxable income be certain, merely that it is bounded from below. Our model could be modified

of default risk. Say the lessor's initial portfolio choice is one unit in each lease. We assume that the lessor can still choose to invest either a larger or smaller amount in each without affecting lease rentals. We assume away any problems of divisibility of leases. The lessor may now review the proposed portfolio using our efficiency (i.e., least-cost) criterion. If it is possible to increase the NPV of the portfolio without displacing additional taxable earnings in any year, then this should be done. For the lessor's (initial) portfolio $\underline{x}^\circ$ to be efficient, it must be an optimum solution to the linear programming (LP) problem:

$$\max \underline{p}'\underline{x}$$

subject to

$$A\underline{x} \leq A\underline{x}^\circ$$
$$\underline{x} \geq 0. \tag{1}$$

The notation is as follows. The vector $\underline{x}$ represents the number of units of investment made in each lease in an optimized portfolio that consumes no more taxable earnings than the original portfolio $\underline{x}^\circ$.[10] Note that we are claiming only that $\underline{x}$ is at least as good as $\underline{x}^\circ$. We do not claim that it represents an optimum optimorum. The row vector $\underline{p}'$ contains the net present value of each lease. The upper case A denotes the matrix (a_{ij}) giving the amount of taxable earnings displaced by lease j in period i. These coefficients are calculated on the assumption that the lease is funded to give an immediate cash flow of p_j and zero cash flows in future periods.[11] In order to obtain y_t, the shadow prices today of taxable earnings in each future period, we solve the dual of the problem stated in equation (1),

$$\min \underline{b}'\underline{y}$$

subject to

$$A'\underline{y} \geq \underline{p}$$
$$\underline{y} \geq 0, \tag{2}$$

where $\underline{b} = A\underline{x}^\circ$ is the vector of earnings displaced by the portfolio and $\underline{y}$ is the vector of prices of taxable earnings.

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to incorporate less restrictive assumptions. We might permit the lessor to construct lease schedules that only use or displace taxable earnings in the current period and generate taxable earnings in all future periods. Thus, if taxable earnings in future periods become negative, this would reduce tax payments to the IRS and increase the lease's NPV.

[10] Short sales are not permitted in this model. The issue of short sales will be discussed in a subsequent section.

[11] Using the loan-balance method described by Franks and Hodges [10], an initial loan can be obtained (calculated by trial and error) that may be repaid exactly and entirely by cash flow income of the lease. The difference between the initial loan and the cost of the asset is the lease's NPV (p_j). Note that the initial loan is chosen so that the net cash flows of the lease and the loan are equal in all periods other than the initial period. See, also, Ruback [22] for a further discussion of this approach.

Leases that are actually written satisfy the pricing relationship:

$$\sum_{i=0}^{I} y_i a_{ij} = p_j, \tag{3}$$

where the value of tax earnings displaced and generated (left-hand side of equation (3)) equals p_j, the traditional NPV of the leases. Leases that the lessor chooses not to write satisfy the inequality condition:

$$\sum_{i=0}^{I} y_i a_{ij} \geq p_j.$$

We may regard each lease j as having an adjusted present value APV_j given by

$$APV_j = P_j - \sum_{i=0}^{I} y_i a_{ij} \leq 0. \tag{4}$$

This is simply the traditionally calculated NPV minus a value imputed to the tax earnings used up (and generated) by the lease. The inequality sign in equation (4) cannot be reversed unless there is rationing of particular types of leases, permitting them to earn economic rents.

It is interesting to compare our formulation of the problem with the bond problem of Hodges and Schaefer [13]. Their LP was one of minimizing the cost of a given stream of after-tax cash flows (subject to a short-sale restriction). Subsequently, Schaefer [23, 24] applied the LP approach to measure the term structure of interest rates facing a particular investor. In his model, cash flow constraints in each period, provided by the initial choice of bond portfolio, gave rise to shadow prices, which revealed the term structure of interest rates. In our model, constraints on taxable earnings in each period give rise to shadow prices, which indicate period by period the marginal value of taxable earnings to a particular lessor.[12]

It is important to appreciate the information required by the lessor in our model. In order to examine the efficiency of a given initial portfolio of leases, it is only necessary to know that leases are currently available in the market place and how the initial portfolio is constituted. As before, the analogy with Schaefer's bond portfolio problem may be helpful. In order to see whether a given portfolio of bonds obtains its cash flows efficiently, all we need are the details of current prices and cash flows offered by available bonds and a LP program. However, the overall choice of a bond portfolio can be made to depend on more complex considerations, such as what the ultimate cash flow requirements from the portfolio are expected to be. Since the bond portfolio will be managed through time and not simply held passively, it also depends on expectations of how interest rates will change through time and on considerations of risk. The lessor's choice of an overall portfolio of leases may be made to depend on similarly complex considerations: for example, forecasts of the taxable earnings that will be available in the future, forecasts of how lease rates will change, and considerations of risk. These issues lie beyond the scope of the current paper.

[12] We can develop upper and lower bounds on the term structure of prices (y_t). For example, if we could costlessly transfer taxable earnings backward and forward through time using a pension fund, then $y_{t+1} = y_t/(1 + R)$. However, if there are limitations to such transfers forward through time, then $y_{t+1} \geq y_t/1 + R$ for a company that has already accelerated its contributions; the inequality will be reversed for a company that has postponed its contributions as far as possible. The interested reader should contact the authors for a more detailed analysis of the bounds on y_t/y_{t+1} using other tax-transfer instruments.

In the next two sections, we examine the conditions under which we would expect the APV of a portfolio of leases to be zero or nonzero.

III. Efficiency and Clienteles in the Leasing Market

Our normative model of lessor portfolio selection raises two important questions concerning the nature of equilibrium in the leasing market. The first question is whether or not leases seem to be priced efficiently, and the second is whether the leasing market is an integrated or a segmented one. Clearly, if the market is integrated and efficient, each lease will have a zero APV to each lessor (and lessors will not have a portfolio problem).[13] Alternatively, we may find that the market is segmented and efficient or that it is segmented and inefficient. In both latter cases, the APVs of some leases to a particular lessor will be negative (while others have a zero APV). We shall examine the empirical evidence in Section IV, but first we define what we mean by "efficiency" and "integration" and describe what conditions are sufficient for the market to have these properties.

A. Efficiency in the Leasing Market

We shall collect a sample of lease rates for different sorts of leases that were offered in the market at a single date. If a single lease from such a sample can be dominated by a portfolio of other leases, then such a lease has a negative net present value (to *all* lessors) and should not have been transacted. By dominate, we mean that the cash flows of a single lease can be replicated by a portfolio of other leases at a lower cost. We will later test this by trying to improve each lease in turn for which we have data. If we can improve on a single lease, this will be evidence of inefficiency in the leasing market. The usual assumptions of competitive markets are sufficient for us to expect all inefficiencies of this type to be removed. This test is exactly that performed by Schaefer [24] on the UK bond market.

It is interesting to speculate as to what frictions might prevent inefficiencies from being competed away in the leasing market. Although there is, in principle, unlimited entry, tax-motivated leasing transactions require the lessor to possess (or to have access to) taxable earnings. As an empirical observation, during the period of the early 1980s, the UK corporate sector was suffering from severe tax exhaustion. As a result, the market was dominated by only a few corporations (mainly banks). This limitation on the number of lessors may have impeded competition. Also, removing inefficiencies requires the writing of a lease, purchasing a specific kind of asset, and locating a potential lessee contemporaneously. Infrequent trading in large leases may impede the speed with which inefficiencies may be removed. Finally, replicating one lease using combinations of other leases may be made costly by the indivisibility of lease contracts.

[13] Note that this does *not* mean that lessors do not make a positive NPV from tax-arbitrage transactions, simply that the net present value of the cash flows of the lease is completely explained by the value of changes in taxable earnings displaced by the lease. In Tables I and II, the NPV of the lease's cash flows is 69.42, but this is completely explained by the value of the earnings changes, so the APV of the lease is zero.

B. Integration in the Leasing Market

An integrated leasing market is one where every lease has a zero APV to all lessors; that is, the net present value of the cash flows of a lease (or portfolio of leases) is completely explained by the value of the taxable earnings displaced by the lease. As a result, the choice of which lease to write becomes irrelevant. Such a condition requires that the leasing market be efficient. If leases have the same APV of zero to all lessors, then this implies a unique term structure of prices of taxable earnings. (That is, $\underset{\sim}{y}$ in equation (2) is the same for every portfolio and every lessor.) In contrast, in a segmented market, different lessors choose different portfolios and face different term structures of prices of taxable earnings.

In principle, we might expect the leasing market to be segmented. First, leasing is a financial instrument like stocks and bonds; evidence by Elton and Gruber [9] and by Schaefer [24] suggests that the markets for both instruments are dominated by clienteles. However, in the case of lessors, we have assumed that all lessors have the same effective tax rate. It may be that evidence of segmentation is an indication that lessors do have different effective tax rates. We know, for example, that some tax-paying companies are subject to statutory delays in tax paying of nine months and others of up to twenty-one months, and, therefore, different delays may occur in the payment of corporation tax. However, it is also known that lessors can set up companies with any financial year-end date for a single lease, providing the lease is sufficiently large to cover the transaction costs. Assuming a single (nominal and effective) corporate tax rate, we describe below three alternative sets of conditions, any one of which would be sufficient to produce an integrated leasing market.

If the opportunities for buying and selling taxable profits (by leasing or other means) are sufficiently complete, then we may be able to conclude that all lessors face the same vector of prices of taxable earnings $\underset{\sim}{y}$ and that, therefore, $\underset{\sim}{y}$ will be independent of the earnings displacement vector $\underset{\sim}{b}$. It would not be necessary for the matrix A to contain positive and negative unit vectors corresponding to each year in order for this to occur. If a well-developed mechanism exists that enables companies to accelerate or defer taxable earnings, at fixed terms of trade, then the shape of the term structure of the value of earnings is fixed, and it will be the same for all participants. It has been suggested to us that the possibility of accelerating or deferring pension fund contributions could play this role. However, although this and other similar mechanisms *could* ensure the uniqueness of prices, we have no evidence that they are sufficiently well developed to actually do so. For the purpose of this paper, we do not need to understand these mechanisms in any detail.

The prices of taxable earnings will also be unique if lessors can costlessly take short positions in leases. Although such short positions can be attained by means of back-to-back leasing arrangements, they will be costly insofar as the IRS rules will require a corresponding long position on a lease based on the same asset.

Finally, there will be a unique term structure of taxable earnings, provided we have sufficient conditions for all lessors to have similar portfolios of leases. As long as there is no gross form of clienteles, then every lessor company will be prepared to take at least some small fraction of every lease in the market.

However, for this to occur, it is at least necessary for lessors to have homogeneous expectations about future lease rates: without this assumption, lessors would obviously hold different portfolios on the basis of which period's earnings they expect to become most valuable. Since it seems very unlikely that lessors will have homogeneous expectations, there is no need for us to specify what other conditions would be required for this argument to imply an integrated market. Thus, although we can state three alternative sets of conditions that would lead to unique prices for taxable earnings, we are forced to doubt as to whether any one of them is satisfied in practice.

IV. Empirical Analysis

In this section, we describe our empirical analysis, which examines two sets of leases. The first set of leases is based on quotations from a lease broker in September 1983, and the second set is based on a sample of 182 leases written by a major lessor during the period February and March 1983. Using these two samples (separately), we test whether the market appears to be a fully integrated one and whether there is any evidence of inefficiencies. We conclude that there is clear and consistent evidence of segmentation in the leasing market, giving rise to clienteles, and some evidence of inefficiency.

A. Sample I: Lease Quotations

The set of lease quotations was representative in that they were not the rates on actual deals, but the rates that the broker felt most likely to apply currently to a prime-risk lessee (equivalent in credit risk to a company with a triple-A credit rating). We obtained ten quotations in all, across three different types of leases and for a range of lease lengths from three to seven years. We checked the quality of our data by obtaining quotations from a second independent broker. The two sets of data were remarkably consistent. In each case, the rentals are constant over the life of the lease and are paid annually in advance. The three types of leases can be classified by the different tax depreciation schedules provided by the UK government. In the first case, one hundred percent tax depreciation is permitted in the first year for particular types of assets. In the second category, one hundred percent tax depreciation is given, but, in addition, a nontaxable cash grant of twenty-two percent of the cost of the asset is provided. (This cash grant is similar to the ITC in the US except that taxable earnings are not required since the grant is received as a cash sum from the IRS.) The third category of leases is based on a tax depreciation schedule of twenty-five percent per annum on a declining balance basis. The first panel of Table III summarizes the details of these leases.

In order to calculate the net present values and earnings effects of these deals, we needed to measure an appropriate term structure of interest rates. An American bank supplied us with current quotations for one-, two-, three-, four-, and five-year Sterling LIBOR rates, which were 10.25, 11.125, 11.25, 11.5, and 11.75 percent, respectively. The bank indicated that it would normally lend to a prime-risk customer (with virtually no risk of default) at 0.375 percent above

Table III

Two Samples of Lease Quotations and Leases Written

Panel I: Lease Quotations (September 1983)					Panel II: Leases Written (February to March 1983)				
ID No.	Depreciation Schedule	Length (Years)	Lessor NPV[a] (Pounds)	Lessee NPV[b] (Pounds)	ID No.	Depreciation Schedule	Length (Years)	No. of Rentals per Year[c]	Lessor NPV (Pounds)
Q1	100%	3	35.46	40.45	W1 (6)[d]	100%	4	12	43.3
Q2	100%	5	39.43	82.35	W2 (8)	100%	5	12	19.1
Q3	100%	6	43.57	98.64	W3 (32)	100%	5	4	27.3
Q4	100%	7	48.32	113.28	W4 (26)	100%	5	4	30.2
					W5 (11)	100%	10	1	61.4
Q5	Cash (22%) Grant	3	37.27	206.38	W6 (2)	Cash (30%) Grant	3	1	20.9
Q6	Cash (22%) Grant	5	45.16	222.3					
Q7	Cash (22%) Grant	7	48.65	104.79					
Q8	25%	5	35.01	−5.94	W7 (5)	25%	5	6	46.0
Q9	25%	6	37.03	6.02	W8 (2)	25%	7	1	29.1
Q10	25%	7	37.67	22.41	W9 (2)	25%	10	1	46.5
			407.57						323.8

[a] Based on the term structure described in the paper. If we had used a second term structure (11, 12 1/2, 13, 13 1/2, 14, 14 1/2, 15, 15 1/2, 16, 16 1/2), the NPVs for individual leases would have changed by between 0.12 and 3.71.

[b] Assuming a permanently tax-exhausted company.

[c] W4, W7, and W9 are variable-rate leases; remainder are fixed-rate leases. The former vary with interest rate changes.

[d] Numbers in parentheses represent number of leases in each subgroup.

LIBOR, which is an interest rate between the T-bill rate and the prime interest rate. From these figures, we calculated the appropriate one-period forward rates for our analysis as 10.63, 12.48, 11.92, 12.83, and 13.49, and we extrapolated later one-period forward rates as 14, 14.5, 15, 15.5, and 16. This term structure produced the net present values to lessors given in the fourth column from the left of Table III. In the final column of the first panel, we have provided the NPV to the lessee, assuming that the latter was permanently tax exhausted. Although the exact tax position of the lessee is unknown, Higson's [11] data suggest that this is a good approximation and that it provides some estimate as to the distribution of the gains from the arbitrage transactions.

B. Sample II: Leases Written during February and March 1983

In the second panel of Table III, we describe a second sample of 182 leases that were written by a major lessor in February and March 1983. Since some similar leases appeared to provide different returns to the lessor, we decided to form as many homogeneous subgroups as possible. The subgroups were distinguished on the basis of (a) the type of tax depreciation, (b) whether a cash grant was available, (c) the length of lease, (d) the frequency of lease rental payments, (e) whether the imputed interest rate was fixed or variable, and (f) the credit risk of the lessee (as described by the lessor). In order to exclude subgroups where we were unsure of the quality of the data, we calculated the mean pretax IRR or yield to the lessee (assuming that the lessee was permanently non-taxpaying) of each subgroup and the standard error of the mean. Only where the standard error was less than 0.5 was the subgroup retained. Only eight subgroups satisfied this criterion, but, for completeness, we decided to include one other subgroup of cash-grant leases that did not satisfy our criterion.[14] Our final nine subgroups represented ninety-four, or approximately half, of the leases written by the lessor.

The sample of leases written has the advantage that transactions took place at the stated prices; however, there are problems of comparison between leases

[14] It is necessary to include particular types of lease transactions such as cash-grant deals in order to avoid a degenerate solution of the values of taxable earnings. This is because the total earnings displayed by a lease, E, can be shown to be

$$E = \frac{D - A - NPV}{1 - \tau},$$

where A is the asset's cost, D is the total tax depreciation allowed, NPV is the net present value of the lease, and τ is the corporate tax rate. For non-grant deals, it follows that (in the notation of equation (2)), $A'\underset{\sim}{z} \equiv \underset{\sim}{p}$ where $\underset{\sim}{z}$ is a constant vector with values $-(1 - \tau)$ in all elements. Hence, if some other vector provides a good explanation of the non-grant lease rates, so that $A'\underset{\sim}{y} = \underset{\sim}{p} - \underset{\sim}{\varepsilon}$ (where $\underset{\sim}{\varepsilon}$ represents residual errors), then

$$A'[\theta\underset{\sim}{y} + (1 + \theta)z] = \underset{\sim}{p} - \theta\underset{\sim}{\varepsilon}$$

for any θ. In the absence of grant deals, our estimates from the dual problem will be as far along the ray toward $\underset{\sim}{z}$ as is consistent with the constraints put on the estimation (i.e., that $\theta\underset{\sim}{y} + (1 - \theta)\underset{\sim}{z} > 0$). For grant deals $A'\underset{\sim}{z} \equiv \underset{\sim}{p} - \underset{\sim}{k}$ (where $\underset{\sim}{k} = D - A$ is typically quite large, e.g., twenty-two percent of the asset cost) and $A'[\theta\underset{\sim}{y} + (1 - \theta)\underset{\sim}{z}] = \underset{\sim}{p} - \theta\underset{\sim}{\varepsilon}(1 - \theta)\underset{\sim}{k}$. In this case, the point $\underset{\sim}{z}$ of degeneracy is not a problem.

because of their many dimensions. The quotations data do not suffer from any problems of heterogeneity and comparability, and the leases are virtually free of default risk. However, leases may not have been transacted at those prices. Although there are some problems with the characteristics of both samples, the problems are rather different, and we believe the two samples are complementary to each other.

V. The Results

Once we had calculated the NPVs and the earnings effects of our leases, we used them to examine the structure of the leasing market by looking at the efficiency of various portfolios. We first looked for evidence on whether the market seemed to be an integrated one by taking an initial portfolio consisting of one unit of each of the ten representative leases described in Panel I and one unit of each of the nine representative leases in Panel II of Table III and then changing the composition to see how much of the NPV of each of the portfolios could be improved. Each unit of a lease was written on an asset costing £1000; thus, a portfolio of ten units of leases involved the purchase of assets totalling £10,000. The results of this test using lease quotations are shown in Table IV. From Table III, we can say the initial portfolio had a net present value of £407.6, and, by changing to the holdings in the first column of Table IV, we were able to improve

Table IV

Improvements to Lease Portfolio Using Quotations Data and Sample of Leases Written

Quotations Data			Leases Written		
ID	New Holdings	APV (Pounds)	ID	New Holdings	APV (Pounds)
100% Allowance					
Q1	3.56	0	W1	2.34	0
Q2	1.68	0	W2	0	−22.3
Q3	0	−14.0	W3	0	−22.8
Q4	0	−18.0	W4	0	−19.4
			W5	3.58	0
Cash Grant					
Q5	0	−40.1	W6	0	−33.6
Q6	0	−33.5			
Q7	0	−46.7			
25% Allowance					
Q8	2.72	0	W7	3.0	0
Q9	5.01	0	W8	0	−25.6
Q10	2.31	0	W9	0	−11.7
Total Saving		152.4	Total Saving		135.3

Initial portfolio consists of one unit in each lease.

Using the quotations data, we measured how sensitive the savings were to the term structure. Under the second term structure referred to in Table III, the total savings were 130.1.

Note that APVs are zero or less than zero. Only leases with zero APVs are included in the final portfolio.

Table V

Estimates of the Price of a Unit of Taxable Earnings

	Prices (Dual Values): Pence per Pound of Taxable Earnings	
Year	Quotations	Leases Written
1	12.4	9.0
2	30.2	9.0
3		
4		
5	12.3	
6	5.1	
7		
8	2.4	
9		
10		
11		
12		
13		
14		
15		150.1[a]

[a] The price in year 15 is acting as a dummy variable for long leases. We expect that a larger sample of leases would make it better behaved.

this by £152.4. Thus, the NPV expressed as a proportion of the (pretax) purchase cost of the assets improved from 4.08 to 5.6 percent. An entry of 3.56 for the lease subgroup labeled Q1 means that 3.56 units of that lease are in the new portfolio as opposed to 1.0 in the initial portfolio. The second column shows the APVs of the individual leases; for example, by omitting entirely the leases designated Q3, we can improve the portfolio's value by £14.0. Also, the grant leases are quite substantially negative with respect to this initial portfolio. The results are not very sensitive to our estimate of the term structure of interest rates. (See footnote 1 to Table III).

In the second part of Table IV, we provide the results for the lease portfolio using the nine groups of leases described in the second panel of Table III. Again, we assume that the initial portfolio contains one unit invested in each group of leases. The results are very similar to those found with the sample of quotations. We find that the NPV of the original portfolio of £323.8 could be increased by £135.3 by changing its composition, using our LP procedure. It is important to appreciate that these improvements to the profitability of the portfolio of leases include all the costs relating to the transaction. This evidence suggests a market that is segmented and characterized by clienteles.[15]

[15] A segmented leasing market may result from the regulatory nature of the UK banking industry. There are only five large banks in the UK, and, because of large taxable earnings, their leasing subsidiaries were the major players in tax-motivated lease transactions in the early 1980s. It may be that reserve requirements imposed by the Bank of England have restricted the ability of one or more

If the market had shown no signs of segmentation, then the vector of prices of taxable earnings would not depend on the taxable earnings sought, and any company would have used this vector to price any lease (and also to price taxable earnings in other contexts such as tax interactions of projects described by Cooper and Franks). Since there is evidence of clienteles, we should not expect any two samples of leases to produce identical vectors of prices. Table V presents evidence on the form of the term structure of prices of taxable earnings for both samples of leases. The first column shows the shadow prices that we obtained from the portfolio problem of Table III based on quotations data; note how the prices differ across the term structure. The 12.4 pence per pound sterling value in year one from lease quotations may be interpreted as an effective tax rate of 39.6 percent (52 − 12.4) instead of the (then statutory) fifty-two percent rate. The prices obtained from the sample of leases written are quite different. Although it is rather disappointing that our estimates of prices are so sensitive to the sample of leases, we do not find this surprising. The point made in footnote 14 provides a theoretical reason why $\underset{\sim}{y}$ is difficult to measure accurately. We have also found empirically that the values estimated for the present prices of future taxable income $\underset{\sim}{y}$ are rather sensitive to details of the estimation method. In contrast, the APV of leases and the constituents of efficient lease portfolios are rather robust to estimates of $\underset{\sim}{y}$.[16]

Finally, Table VI shows the results of our test of market efficiency using lease quotations and the leases written. We have taken one lease at a time and tried to dominate it by a portfolio of remaining losses. The first column of the table shows by how much each lease can be dominated, that is, the extra NPV that can be obtained with no adverse effect on taxable earnings. The cash-grant leases for both samples are all severely dominated and provide evidence of inefficiency. However, it may be that there are other unknown but valuable factors that we have ignored.[17]

VI. Conclusions

Our theoretical model leads us to the following main conclusions. When aggregate taxable earnings are scarce in the economy, we would expect to observe lessors

banks to write leases of particular maturities, leading to the rationing of certain kinds of leases. Also, each bank traditionally has self-imposed ceilings on lending to given industries. If some types of lease contracts are concentrated in particular industries, where some banks have reached their self-imposed ceilings, there may be a rationing of some leases.

[16] For example, we measured the improvements to the lease portfolio (using sample I) when imposing bounds on successive y_t's to be monotonically decreasing and constraining *changes* in the initial lease portfolio to a maximum of one unit for each lease. The APV of this constrained and bounded problem was 117.5, compared to 135.3 for the unconstrained and unbounded problem in Table IV. This provides some evidence for our claims of robustness.

[17] One source of uncertainty that has been omitted in this model is that relating to the tax rate. It may also be that the probability of an increase in the tax rates is greater than a reduction; this will affect the lease's value.

Table VI

Tests of Market Efficiency Using Quotations Data and Samples of Leases Written

Amount by Which Each Lease Is Dominated[a]			
ID No.	Quotations Data	ID No.	Samples of Leases Written
Q1	—	W1	—
Q2	—	W2	—
Q3	—	W3	—
Q4	—	W4	—
		W5	—
Q5	31.4	W6	33.1
Q6	33.1		
Q7	42.7		
Q8	—	W7	—
Q9	—	W8	—
Q10	—	W9	—

[a] Pounds per thousand of asset purchased.

earning positive net present values on the cash flows of individual leases. If taxable earnings are scarce, they have value. Their value is measured by the extent to which a dollar of taxable earnings enables a present-value saving to be made in future tax liabilities. A lease has an APV of zero to a lessor if the value of the taxable earnings used in a lease contract is equal to the lease's NPV of its cash flows. This theory enables us to reconcile the apparently conflicting views of Miller and Upton [19] and Myers, Dill and Bautista [21]. If an individual lease did have a nonzero APV, it could only be because of clienteles or inefficiencies. Our model for valuing leases within a portfolio context allows the lessor to write only those leases that are consistent with its clientele and permits it to exploit any inefficiencies; this places an entirely new perspective on lessor analysis.

Our empirical analysis suggested that the market is not simply segmented, for we also found evidence of apparent market inefficiency. There are leases in the market with positive NPVs to lessors that are entirely dominated by other leases. Either there are some further priced factors that we have omitted or some types of leases were consistently mispriced.

In principle, empirical estimates of the prices of taxable earnings have uses beyond those to do with analyzing leases—for example, as a transfer price for when one division of a company uses the taxable earnings of another division to shelter its own tax losses. Such market prices would provide a simplification of the problem of project interactions described by Cooper and Franks [2]. However, our empirical work found that those prices depend rather critically on the earnings displacement sought by a particular company. Finally, if taxable profits are a priced resource for the lessor, tax losses play a similar role for the lessee. Lessee valuation should take account of the effect a lease will have on its tax-exhaustion position.

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