# Leasing, Ability to Repossess, and Debt Capacity*†

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**Abstract**

This paper studies the role of leasing of productive assets. When capital is leased (or rented), it is more easily repossessed and hence leasing has higher debt capacity and relaxes financing constraints. However, leasing gives rise to an agency problem with regard to the care with which the leased asset is used or maintained. We show that this implies that more credit constrained firms lease capital, while less credit constrained firms buy capital. Our theory is consistent with the explanation of leasing provided by leasing firms, namely that leasing "preserves capital," which is generally considered a fallacy in the academic literature. We provide empirical evidence that small and credit constrained firms lease a considerably larger fraction of their capital than larger and less constrained firms.

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# 1 Introduction

The ability of the lessor to repossess an asset is a major benefit of leasing. This ability to repossess allows a lessor to implicitly extend more credit than a lender whose claim is secured by the same asset. The debt capacity of leasing thus exceeds the debt capacity of secured lending. This makes leasing valuable to credit constrained firms.

When an asset is leased, however, the asset is under the control of a user who is not the owner. Leasing hence involves a separation of ownership and control, which is costly due to agency problems. The benefit of leasing in terms of the ease with which an owner can repossess the asset has to be weighed against the cost due to the agency problem. The benefit will outweigh the cost for firms which are more credit constrained, while firms which are less credit constrained or unconstrained prefer to own assets.

In the U.S. bankruptcy code, leasing and secured lending are treated quite differently. In Chapter 11, the lessee has the choice between either assuming the lease, which means keeping control of the asset and continuing to make the specified payments, or rejecting the lease and returning the asset. In contrast, the collateral which secures the claim of a secured lender is subject to automatic stay in Chapter 11, which prohibits recovery of or foreclosure on the property. Thus, in bankruptcy it is much easier for a lessor to regain control of an asset than it is for a secured lender to repossess it. The ease with which a lessor and a lender can repossess an asset in bankruptcy moreover affects their bargaining power outside of bankruptcy and hence affects what they can reasonably expect to be repaid outside of bankruptcy as well.

Thus, U.S. statutes clearly make repossession easier for a lessor than for a secured lender. More generally, and in most legal environments, one might expect that it is typically easier for the owner of an asset to regain control of it, than it is for a lender who takes a security interest in an asset to repossess it. Allocating ownership to the agent providing financing strengthens the financier's claim by facilitating repossession. This is turn allows the financier to extend more credit. Allocating ownership to the user of the capital, in contrast, is efficient since it minimizes the agency costs due to the separation of ownership and control. It is this basic tradeoff which we think determines to a large extent whether it is advantageous to lease, which means that the financier retains ownership, or buy, which means that the financier merely takes a security interest in the asset.

Interestingly, the main argument for leasing typically given by leasing firms is that

it "conserves cash," provides "100 percent financing," or "preserves credit lines." This is indeed the advantage of leasing as argued above, since the debt capacity of leasing exceeds the debt capacity of secured lending. In contrast, this argument is generally considered a fallacy in the academic literature.[1] For example, Brealey, Myers, and Allen (2005), list "leasing preserves capital" as one of the dubious reasons for leasing and argue as follows (p. 702):[2]

> Leasing companies provide "100 percent financing;" they advance the full cost of the leased asset. Consequently, they often claim that leasing preserves capital, allowing the firm to save its cash for other things.
>
> But the firm can also "preserve capital" by borrowing money. If Greymare Bus Lines leases a $100,000 bus rather than buying it, it does conserve $100,000 cash. It could also (1) buy the bus for cash and (2) borrow $100,000, using the bus as security. Its bank balance ends up the same whether it leases or buys and borrows. It has the bus in either case, and it incurs a $100,000 liability in either case. What's so special about leasing?

Similarly, Schallheim (1994) argues that (p. 6-7):

> Consider the case for "100 percent financing," a reason for leasing advertised by almost every leasing company in the world. ... If a firm qualifies for a lease with its so-called 100 percent financing, it also is possible that the firm can borrow 100 percent of the asset cost at some market-determined price or interest rate. (Bank financing usually requires a down payment of 20 percent to 40 percent of the asset cost. Yet a down payment can be borrowed from other sources, or the entire asset cost may be borrowed from non-bank institutions.) Yet 100 percent financing remains a popular advertising approach, especially to small lessee firms or for venture leases.

[1] Practitioners in turn argue that the academic literature has gotten the answer wrong. For example, Andrew and Gilstad (2005) write that "business schools typically teach that leasing is a zero-sum game. However, the economic assumptions that lead to this belief often are not true. These incorrect assumptions have caused serious confusion and bias in lease evaluation for more than a generation." In particular, they argue that there is a "failure to seriously consider the differences that exist between the financial characteristics of the lessor and the lessee beyond tax rates."

[2] See also Ross, Westerfield, and Jaffe (2002), p. 604, who include "one hundred-percent financing" on a similar list.

We argue that what is special about leasing is the relative ease with which the leased asset can be repossessed. Given this, it is not the case that the firm could borrow the same amount from a lender. The higher debt capacity of leasing is a particularly important reason to lease for small firms and new ventures, which are likely severely credit constrained.

There is an extensive literature on leasing in finance, but its focus is almost exclusively on the tax-incentives for leasing, following, e.g., Miller and Upton (1976) and Myers, Dill, and Bautista (1976).[3] In contrast, agency problems have received far less attention. That leasing involves agency costs due to the separation of ownership and control has been recognized for example by Alchian and Demsetz (1972). However, the fact that leasing is associated with a repossession advantage relative to secured lending has not been modeled to the best of our knowledge. Nor has the literature argued that the greater ability to repossess means that the debt capacity of leasing is higher. The repossession advantage has been discussed informally in the literature (see, e.g., Smith and Wakeman (1985), Krishnan and Moyer (1994), and Sharpe and Nguyen (1995)). Most notably, Smith and Wakeman (1985) provide a discussion of both tax and nontax determinants of the lease vs. buy decision and argue that (p. 899) "it is simpler for a lessor to regain physical possession of a leased asset either prior to or after the declaration of bankruptcy than for a secured debtholder to acquire the pledged asset." Their list of eight nontax reasons to lease in the conclusions of their paper however does not include the "leasing preserves capital" explanation due to the greater ability of the lessor to repossess the asset.

We provide empirical evidence that small firms and firms which appear more credit constrained lease a considerably larger fraction of their capital using micro data from the U.S. Census of Manufactures and Compustat. We find that the fraction of capital that firms lease is significantly related to firm size, decreasing from 46% for small firms to 11% for large firms. We find furthermore that firms which pay lower dividends (relative to assets), have lower cash flow (relative to assets), and have higher Tobin's $q$ lease a significantly larger fraction of their capital. Moreover, as a mode of financing leasing is of comparable importance to long-term debt even for relatively large firms: the fraction of capital that firms lease in our merged Census-Compustat data is 16% which is similar to the long-term debt to assets ratio of 19%.[4] Our data

[3] A more extensive review of the literature is provided in Section 5 below.

[4] See also Graham, Lemmon, and Schallheim (1998) who report that operating leases, capital leases, and debt are 42%, 6%, and 52% of fixed claims, respectively, in 1981-1992 Compustat data.

hence seems to suggest that for small firms leasing likely is the most important source of external finance. Related empirical evidence is provided by Krishnan and Moyer (1994) and Sharpe and Nguyen (1995). Both these papers provide evidence consistent with our prediction that more credit constrained firms lease more. Finally, Slovin, Sushka, and Poloncheck (1990) and Ezzell and Vora (2001) provide evidence which suggests that sale-and-leaseback transactions are associated with positive abnormal returns and the latter in addition provides evidence that these returns are positively related to the extent of a firm's financial constraints. These papers assume that such transactions keep the net amount of financing constant, whereas our theory suggests that sale-and-leaseback transactions free up capital and thus provides an alternative interpretation of their results.[5]

Our focus is on the specific relative advantage of leasing over secured lending in the U.S. The extent of this relative advantage varies across different countries. For example, in the U.K., recovery or foreclosure by a secured lender is much easier than in the U.S., and hence the relative advantage of leasing may be reduced. This suggests interesting testable implications regarding the prevalence of leasing vs. secured lending in different legal environments.[6] We discuss several additional implications of the effect of financial constraints on leasing for corporate finance and macroeconomics in the conclusions.

# 2 Leasing versus Secured Lending

The main difference between leasing and secured lending from our vantage point is its treatment in bankruptcy. We start by discussing the main difference between the

[5]For example, Women's Wear Daily (April 20, 2005) reports that "A&G has sold Asprey's Bond Street store to Quinlan Private, the Irish property group, ... A&G Group said it planned to use the proceeds to fund its international expansion program. ... the current building has been handed back to A&G Group on a long-term lease that will last for at least 25 years." Similarly, the Wall Street Journal (September 13, 2004) reports that "Krispy Kreme also gave details of a sale-leaseback deal ... saying it had sold six stores for $17.3 million and agreed to lease them back for 20 years. The company had previously confirmed that some proceeds of the deal were used to fund continuing operations ... Some accounting experts said the sale-leaseback might be an indication of a cash crunch."

[6]The difference between the treatment of leasing and secured lending in the U.S. provides firms who need financing with a choice regarding the ability of a financier to repossess assets which may be valuable. Firms which are more constrained then choose to lease, which means they choose to issue tougher claims, while firms which prefer to issue weaker claims issue secured debt.

treatment of a true lease and a claim with a security interest in bankruptcy. That is, we start by discussing the differences from a legal perspective. We then provide a more detailed discussion of the differences from the taxation and accounting perspective as well. An overview of the classifications for legal, tax and accounting purposes is provided in Table 1. Broadly speaking, the picture is as follows: While there are differences between the three classifications, they are actually highly correlated. Moreover, the differences across different types of leases and secured debt are a matter of degree since the classification of a specific transaction depends on a variety of characteristics. In particular, the ability to repossess gradually decreases as a lease starts to look more like secured debt, and hence as more of the property rights are allocated to the user.[7] There seems to be an important link between the retension of property rights and the ability to repossess.

Bankruptcy law and commercial law distinguish between a "true lease" and a lease intended as security, which means that the lease merely establishes a "security interest" in the asset.[8] A true lease is an executory contract. This means that the obligations of both parties to the contract remain largely to be performed. In a true lease, the lessor retains effective ownership. In Chapter 11, the lessee faces a choice between assuming the lease and rejecting the lease. If the lessee assumes the lease, he has to continue to make the scheduled payments and, if there has been a default, it has to be cured to assume the lease. In addition, the lease becomes a post-petition liability and the lessor has hence effectively a first priority claim. If the lessee rejects the lease, he has to return the asset to the lessor. Any additional claims that the lessor has are then unsecured claims in bankruptcy.

If the lease is intended as security, or recharacterized by the bankruptcy judge as such, the lessor is effectively treated like any other secured lender. That is, the lessee acquires effective ownership. Most importantly the collateral is then subject to automatic stay, which prohibits recovery of or foreclosure on the collateral. The debtor is typically allowed to continue to use the asset. However, a secured lender may be entitled to protection against a decline in collateral value over the course

[7]Ayotte and Goan (2005) provide an interesting related argument for the benefits of securitization over secured debt. For an analysis of secured debt, see Stulz and Johnson (1985), who argue that secured debt limits the underinvestment problem. This is an interesting, but different explanation for secured lending from the explanation in our model. Moreover, Stulz and Johnson do not distinguish between secured debt and leasing.

[8]See Ayer and Bernstein (2002) and Ayer, Bernstein, and Friedland (2003, 2004a,b) for a clear discussion of the issues analyzed in this section, which is addressed to Chapter 11 professionals.

of a bankruptcy case. But the inconvenience of automatic stay is not sufficient to obtain adequate protection. In short, while the secured lender is not completely unprotected, he is clearly in a much weaker position than the lessor in a true lease.

Whether or not the lease is a true lease, or merely establishes a security interest, depends on the duration of the lease (relative to the economic life of the asset), the extent to which the lessee is bound to renew the lease for the remaining life or bound to become the owner, the extent to which the lessee has options to renew or become the owner for no additional (or nominal) payments, among other factors (see Table 1 for details). The more the lease seems to allocate control with the lessee and the more the lessee seems to be expected to end up as the residual claimant of the asset, the more likely the lessee is to be treated as effective owner.

The classification criteria from the perspective of taxation and accounting have a similar spirit (see again Table 1 for details). The tax law distinguishes between a "true lease" and a "conditional sales contract." To qualify as a true lease, a lower bound on the extent to which the lessor is the residual claimant has to be met. In addition, an upper bound on the extent of control of the asset by the lessee cannot be exceeded. The accounting rules in turn distinguish between an "operating lease" and a "capital lease." The criteria for classification are however quite similar to the criteria for tax purposes.

The tax and accounting classification of course affect who treats the asset as a capital asset and depreciates it for tax and accounting purposes, respectively. There is however a connection between the various classifications. Operating leases are usually true leases for tax and legal purposes. Capital leases are often considered conditional sales contracts for tax purposes with two important caveats: First, a lease with a term exceeding 75% of the asset's economic life but not exceeding 80% will be a capital lease for accounting purposes but a true lease for tax purposes. Second, by making different assumptions about economic life, residual value, and so on for accounting and tax purposes, a lessee has some additional leeway to have a capital lease treated as a true lease for tax purposes. Importantly, whether a lease is considered a true lease for tax purposes and an operating lease for accounting purposes may affect how it will be characterized for legal purposes and hence may affect its treatment in bankruptcy.

To sum up, the ability to repossess is an advantage of true leases from the legal perspective. From the accounting perspective, this advantage is hence primarily enjoyed by operating leases, although some capital leases may enjoy the same advan-

tage. This is important in interpreting empirical work which uses accounting data or census data which is based on accounting classifications as we discuss below.

# 3 A Model of Leasing

In this section we consider a model of the choice between buying capital and leasing capital. We study an environment where leased capital is more easily repossessed by the lessor, since he retains ownership, but depreciates faster due to the separation of the ownership and control of the capital. The interest rate at which agents can borrow and lend is determined in equilibrium. Agents who are sufficiently credit constrained lease capital whereas agents who are less constrained or unconstrained own all their capital. We also discuss an extension to our model which provides a resolution to the leasing puzzle of Ang and Peterson (1984).

## 3.1 Environment

The environment is similar to Eisfeldt and Rampini (2005b). Consider an economy with two dates, 0 and 1. There is a continuum of agents of measure one. Agents have identical preferences and access to the same production technologies, but differ in the idiosyncratic endowment of consumption goods that they are born with, i.e., in the amount of internal funds that they have. The preferences of agents are

$$u(c_0) + \beta u(c_1)$$

where $u$ is strictly increasing and concave and satisfies $\lim_{c\to 0} u'(c) = +\infty$.[9] At time 0, each agent observes his idiosyncratic endowment $e \in \mathcal{E} \subset \mathbb{R}_+$, which is distributed independently and identically across agents with density $\pi(e)$ on $\mathcal{E}$.

Agents have access to a concave production technology which produces output at time 1 of $y = f(k) = k^\alpha$, where $k$ is the amount of capital deployed by the agent and $\alpha \in (0, 1)$. Agents can buy capital ($i_b$) and/or lease (or rent, which is equivalent) capital ($i_l$). Owned (or bought) capital and leased capital are assumed to be perfect substitutes in production, i.e., $k = i_b + i_l$.

[9]The assumption of strict concavity of the utility function is not necessary for our results as long as the production function is strictly concave. We could, indeed, assume linear preferences, that is, risk neutrality.

Capital can be bought at a price of 1 at time 0, depreciates at a rate of $\delta \in (0,1)$, and the (depreciated) owned capital can be sold at a price of 1 per unit of capital.[10] Agents can borrow against a fraction $\theta$ of the resale value of owned capital such that the borrowing constraint reads:

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

where $b$ is the amount borrowed at time 0, $i_b$ is the amount of capital bought, and $R$ is the gross interest rate which will be determined in equilibrium.[11]

Capital can also be leased. The benefit of leasing is that the leasing company can repossess the (depreciated) leased capital at time 1 and thus its repossession technology is better than the repossession technology of the lenders (who can only repossess a fraction $\theta$ of capital).[12] The cost of leasing is that leased capital is subject to an agency problem with regard to the care with which the leased capital is used or maintained and hence depreciates at a rate $\delta_l \in (0,1)$, where $\delta_l > \delta$. We do not model the specifics of the agency problem here, but we provide a description of a contracting environment where these properties obtain at the optimal contract in Appendix A. Moreover, we discuss the economic nature of the agency problem in more detail below. The leasing contract is as follows: An agent who leases $i_l$ units of capital pays a leasing fee of $u_l i_l$ at time 0 (where $u_l$ is the leasing rate per unit of capital which will turn out to be the user cost of leased capital) and nothing at time 1. At time 1, the depreciated leased capital will simply be returned to the lessor and no other payments to the lessor are required (in fact, no additional payments could be enforced). This implies a leasing rate of $u_l = 1 - R^{-1}(1-\delta_l)$, as we show below. Assume furthermore that $1-\delta_l > \theta(1-\delta)$. This assumption ensures that a lessor is able to extend more credit, per unit of capital, than a secured lender.[13]

The idea that separating ownership and control results in greater depreciation of capital goes back to at least Alchian and Demsetz (1972). They argue as follows

[10] Notice that we assume here that the price on new and used capital is the same, in contrast to Eisfeldt and Rampini (2005b), in order to focus on the lease vs. buy decision.

[11] For models with a similar borrowing constraint see Hart and Moore (1994) and Kiyotaki and Moore (1997).

[12] We assume that the lessor can repossess the entire (depreciated) leased capital for simplicity, but there would be a benefit to leasing as long as the fraction that the lessor can repossess exceeds $\theta$.

[13] This amounts to assuming that the agency problem is not so severe, that the leased capital depreciates so much that less remains after depreciation than the amount of depreciated owned capital that a secured lender could repossess.

(p. 792): "But suppose the hammer were destructible and that careless (which is easier than careful) use is more abusive and causes greater depreciation of the hammer. Suppose in addition the abuse is easier to detect by observing the way it is used than by observing only the hammer after its use ... If the hammer were rented and used in the absence of the owner, the depreciation would be greater than if the use were observed buy the owner and the user charged in accord with the imposed depreciation. (Careless use is more likely than careful use – if one does not pay for the greater depreciation.) An absentee owner would therefore ask for a higher rental price because of the higher *expected* user cost than if the item were used by the owner. ... Renting is therefore in this case more costly than owner use." In our model this is captured by the assumption that $\delta_l > \delta$ and will indeed be reflected in the user cost of leased capital.

One might be concerned that, if depreciation is hard to observe after use, it may also be hard to sell the hammer later on. To address this concern, suppose instead that depreciation is observable, but not verifiable, and that a lessor cannot commit not to hold up the lessee ex post by claiming that depreciation was high.[14] Given that the lessee expects to be held up by the lessor, he will use the hammer carelessly. In contrast, an owner user will be able to sell the used hammer at the appropriate price and hence will have an incentive for careful use. One might expect that the hold-up problem induced by leasing could be easily solved by giving the lessee an option to buy (see, e.g., Nöldeke and Schmidt (1998)). However, the more property rights, even conditional property rights, one gives to the lessee, the harder it gets to repossess the asset. Thus, an option to buy might reduce the repossession advantage of leasing. We might hence expect purchase options to be used less frequently when the lessee values the tougher lease claims as a way to relax credit constraints.

## 3.2 Agent's Problem

Consider the problem of an agent with an idiosyncratic endowment, or internal funds, $e \in \mathcal{E}$. Taking the interest rate $R$, the leasing fee $u_l$, and his internal funds $e$ as given, the agent's problem is one of maximizing utility by choosing consumptions $\{c_0, c_1\}$, purchases of (owned) capital $i_b$, an amount of capital to lease $i_l$, and an amount of

[14] This is effectively what we assume in the environment discussed in Appendix A. See, e.g., Klein, Crawford, and Alchian (1978) for a discussion of post-contractual opportunistic behavior.

capital to borrow $b$, i.e.,

$$\max_{(c_0,c_1,i_b,i_l,b)\in\mathbb{R}^4_+\times\mathbb{R}} u(c_0)+\beta u(c_1)$$

subject to

$$c_0 + u_l i_l + i_b \leq e + b$$

$$c_1 + Rb \leq k^\alpha + i_b(1-\delta)$$

where $k \equiv i_b + i_l$ and

$$Rb \leq \theta i_b(1-\delta).$$

Before characterizing the solution to the agent's problem, we discuss the problem of a leasing firm and define an equilibrium.

## 3.3 Lessor's Problem

Consider the problem of a competitive lessor, which maximizes profits, taking the leasing charge $u_l$ as given. To provide an amount of capital $i_l$ to the lessee, the lessor needs to purchase that amount of capital at time 0 and will be able to sell the amount of capital $i_l(1-\delta_l)$ at time 1. Discounting cash flows at time 1 at rate $R$ the lessor's problem is hence

$$\max_{i_l} u_l i_l - i_l + R^{-1} i_l(1-\delta_l).$$

The first order condition of the lessor's problem hence implies that

$$u_l = 1 - R^{-1}(1-\delta_l)$$

and the lessor makes zero profits in equilibrium. We do not need to consider the question of ownership of the leasing firms since these make zero profit. However, we could think of the unconstrained agents as owning and running the leasing firms. This would, in turn, explain why leasing firms do not face credit constraints and discount cash flows at rate $R$.

Notice that the leasing charge $u_l$ is paid up front. This is due to the fact that the agent cannot commit to make extra payments at time 1, since all the lessor can do is recover $i_l(1-\delta_l)$. Moreover, leasing can be interpreted as involving an implicit loan $b_l = R^{-1} i_l(1-\delta_l)$. This implicit loan exceeds the amount that a secured lender can lend per unit of capital (which is $R^{-1}\theta(1-\delta)$) given our assumption, which is the benefit of leasing. It is in this sense that leasing "preserves capital." Leasing

provides "100 percent financing" since the lessee needs internal funds in the amount of the one period user cost only. The user cost is paid up front, so this is not quite 100 percent financing, but it is rather close.

## 3.4 Equilibrium

An economy can be described by the agent's utility function and discount rate along with the technology parameters for the production function, the depreciation rate for owned capital and leased capital, the collateralization rate, and the support and distribution over initial endowments of internal funds. Thus, an economy $\mathbb{E}$ is defined by $\mathbb{E} = \{u(\cdot), \beta, \alpha, \delta, \delta_l, \theta, \mathcal{E}, \pi(e)\}$.

**Definition 1** *An equilibrium for an economy $\mathbb{E}$ is a (gross) interest rate $R$ and an allocation $\{c_0^*, c_1^*, i_b^*, i_l^*, b^*\}$ of consumptions $\{c_0^*(e), c_1^*(e)\}$, capital purchases $\{i_b^*(e)\}$, leased capital $\{i_l^*(e)\}$ and borrowing $\{b^*(e)\}$ for all $e \in \mathcal{E}$ such that the following conditions are satisfied:*

**(i)** *The allocation $\{c_0^*, c_1^*, i_b^*, i_l^*, b^*\}$ solves the problem of each agent, $\forall e \in \mathcal{E}$.*

**(ii)** *The (gross) interest rate $R$ is such that the capital market clears, i.e., such that the total borrowing either directly or indirectly through implicit leasing debt equals total savings:*

$$\sum_{e \in \mathcal{E}} \pi(e) b^*(e) + \sum_{e \in \mathcal{E}} \pi(e) b_l^*(e) = 0$$

*where $b_l^*(e) = R^{-1} i_l^*(e)(1 - \delta_l)$ is the implicit leasing debt.*

**(iii)** *The leasing charge $u_l$ satisfies $u_l = 1 - R^{-1}(1 - \delta_l)$.*

## 3.5 Analytical Characterization

First, observe that an agent who is not financially constrained (i.e., whose borrowing constraint is not binding) and hence discounts cash flows at the market interest rate $R$, owns all his capital and invests a constant amount. The user cost of owned capital to an unconstrained agent is

$$u_b \equiv 1 - R^{-1}(1 - \delta)$$

while the user cost of leased capital, as derived above, is $u_l \equiv 1 - R^{-1}(1-\delta_l)$. Hence, $u_b < u_l$, and a financially unconstrained firm thus prefers to buy capital. Leasing capital would separate ownership and control and imply a higher rate of depreciation without any benefit to an unconstrained agent.

Agents who are financially constrained may lease some or all of their capital. To see this consider the cash flows of buying versus leasing in Table 2. Per unit of capital, buying (and taking out a secured loan) requires a bigger investment (i.e., a larger cash outflow) at time 0 than leasing. But buying involves a positive cash flow at time 1 as some of the investment of internal funds is recovered when the asset is sold, in contrast to leasing which is associated with a zero cash flow at time 1. The user cost of owned capital from the vantage point of a constrained agent is

$$u_b(e) \equiv (1 - R^{-1}\theta(1-\delta)) - R(e)^{-1}(1-\theta)(1-\delta)$$

where $R(e)$ is the agent-specific discount rate

$$R(e) \equiv \left(\frac{\beta u'(c_1(e))}{u'(c_0(e))}\right)^{-1} = \max\left\{\frac{\alpha k(e)^{\alpha-1}}{1 - R^{-1}(1-\delta_l)}, \frac{\alpha k(e)^{\alpha-1} + (1-\theta)(1-\delta)}{1 - R^{-1}\theta(1-\delta)}\right\}.$$

The discount rate equals the inverse of the marginal rate of substitution or the appropriate marginal rate of transformation, which depends on whether the agent leases capital and/or buys capital (left and right term in the maximization operator, respectively). Since $R(e)$ is decreasing in $e$, the user cost of owned capital $u_b(e)$ is decreasing in $e$ as well. Owned capital is cheaper from the vantage point of a less constrained firm. For an unconstrained firm, the user cost of owned capital simplifies to $u_b = 1 - R^{-1}(1-\delta)$, as discussed above, and is hence less than the user cost of leased capital.

A firm is indifferent between buying and leasing capital if $u_b(e) = u_l$, which implies that the firm is indifferent if its firm-specific discount factor $R(e) = \bar{R}$ where

$$\bar{R} \equiv R\frac{(1-\theta)(1-\delta)}{(1-\theta)(1-\delta) - (\delta_l - \delta)}.$$

Notice that $\bar{R} > R$. Firms with higher discount factors, $R(e) > \bar{R}$, lease capital, and firms with lower discount factors, $R(e) < \bar{R}$ buy capital.

The following proposition summarizes the characterization in more detail:

**Proposition 1** *There exist cutoff levels of internal funds* $0 < \bar{e}_l < \bar{e}_b < \bar{\bar{e}} < \infty$ *and levels of capital* $\bar{k}$ *and* $\bar{\bar{k}}$ *such that (i) agents with internal funds* $e \leq \bar{e}_l$ *lease all*

*their capital and lease an amount which increases in e, (ii) agents with internal funds $\bar{e}_l < e < \bar{e}_b$ both lease and buy capital, substitute toward owned capital as e increases, and invest a constant amount $\bar{k}$ overall, and (iii) agents with internal funds $e \geq \bar{e}_b$ buy all their capital, with agents in the range $\bar{e} < e < \bar{\bar{e}}$ investing an increasing amount of capital and agents with internal funds $e \geq \bar{\bar{e}}$ investing a constant amount $\bar{\bar{k}}$.*

The proof is in Appendix B. The proof also provides analytical expressions for both the cutoff levels and the levels of capital in the proposition.

## 3.6 Numerical Example

To illustrate our results we compute the equilibrium of an example economy numerically. We assume that preferences satisfy $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$. The parameters of the example are in Panel A of Table 3. Panel B of Table 3 and Figure 1 display the results. Total investment is increasing in the amount of internal funds. Firms with few internal funds lease all their capital. Firms in an intermediate range gradually substitute toward owned capital and firms with lots of internal funds buy all their capital. We plot the multiplier on the borrowing constraint (normalized by the marginal utility of consumption at time 0) to show that the extent to which a firm is borrowing constrained is a continuous variable and is decreasing in internal funds. Most interestingly, notice in the top right panel of Figure 1 that the implicit (leasing) debt of small firms is large and is in fact large even relative to the explicit debt of much larger firms. Of course, this depends on parameters and the example is not calibrated, but it is an interesting illustration of the higher debt capacity of leased capital.

## 3.7 The Leasing Puzzle: A Resolution

The leasing puzzle (see Ang and Peterson (1984)) is the observation that firms which lease more capital also have more debt.[15] This is puzzling since we think of leasing and debt as alternative ways of financing and hence would expect a negative correlation between leasing and debt. Thus, Ang and Peterson argue that we should expect leasing and debt to be substitutes, but empirically they seem to be complements.

[15] Our empirical findings provide limited support for this observation, since the relationship between the fraction of capital which is rented and the fraction of debt financing, controlling for industry and other firm characteristics, is only significantly positive in some cases (see Section 4).

An extension of our model provides one resolution of the leasing puzzle. We argue that financially constrained firms will rely on all forms of costly external finance more heavily, i.e., both lease more and take out more (and more costly) loans.[16] Suppose that there are two types of assets, one of which cannot be leased or rented. For example, this may be because the agency problem in terms of the careful use and maintenance for certain types of assets is too large. Financially constrained firms will, in this case, lease the assets which can be leased and take out loans to purchase the assets which cannot be leased. Unconstrained firms will purchase both types of assets to avoid the agency costs of leasing. More interestingly, if one assumes that the fraction against which the firm can borrow ($\theta$) can be increased at a cost, financially constrained firms will be the ones willing to pay this cost in order to relax their constraint and borrow more. The result is that financially constrained firms will have higher debt and must pay higher interest rates ($R(\theta)$) to cover the costs of lending against a larger fraction of assets. Thus, the firms which are willing to use costly "lease financing" are also interested in higher cost debt financing. Lewis and Schallheim (1992) provide an alternative resolution of this puzzle by considering tax reasons for leasing and arguing that leasing preserves tax shields which increases the benefits of debt financing. We think the two explanations are complementary.

Consider the environment from above with the following two changes: First, assume that there is a second technology which for an investment of $i_2$ at time 0 returns output $y_2 = f(i_2) = A_2 i_2^{\alpha}$ at time 1. Suppose moreover that capital used in this second technology cannot be leased but can be used as collateral for secured loans only. Second, assume that the fraction $\theta$ which lenders can repossess can be increased by the lender at a convex cost $\phi(\theta)$ per unit of the loan and that the firm is charged an interest rate $R(\theta)$ as a function of $\theta$. We interpret this cost as the cost of monitoring the collateral or enforcing liens, which raises the fraction of the collateral that the lender could repossess.[17] Moreover, assuming that $\phi(\theta)$ is convex, the agent's problem is concave and hence well behaved. The function $R(\theta)$ will be determined endogenously from the lender's problem, but will be taken as given by the agent.

[16] For example, financially constrained firms also rely more heavily on trade credit, another relatively costly type of external finance (see Petersen and Rajan (1997)).

[17] For example, trade credit may be costly for suppliers to provide, but they may be able to repossess their inputs more easily. We can then interpret the convex costs as the costs of relying more heavily on trade credit (see the section on the related literature for a discussion of the literature on trade credit).

Taking the interest rate function $R(\theta)$, the leasing fee $u_l$, and his internal funds $e$ as given, the agent's problem is then:

$$\max_{(c_0,c_1,i_b,i_l,i_2,b,\theta)\in\mathbb{R}^5_+\times\mathbb{R}\times[\underline{\theta},\bar{\theta}]} u(c_0)+\beta u(c_1)$$

subject to

$$c_0+u_l i_l+i_b+i_2\leq e+b$$

$$c_1+R(\theta)b\leq (i_b+i_l)^\alpha+A_2 i_2^\alpha+(i_b+i_2)(1-\delta)$$

and

$$R(\theta)b\leq \theta(i_b+i_2)(1-\delta).$$

The problem of a competitive lender which maximizes profits and discounts cash flows at time 1 at rate $R$ is to choose a loan $b$ to solve

$$\max_b -b(1+\phi(\theta))+R^{-1}R(\theta)b.$$

The first order condition of the lender's problem hence implies that

$$R(\theta)\equiv R(1+\phi(\theta)).$$

The borrower has to compensate the lender for both the opportunity cost of funds and the cost incurred in raising the collateralization rate. Given that, lenders make zero profits in equilibrium. The lessor's problem is unchanged. Notice that in equilibrium both lenders and lessors are unconstrained and hence discount future cash flows at rate $R$. An equilibrium is defined analogously to above, with the allocation extended to include choices of $i_2$ and $\theta$. Also, the market clearing condition for loans now includes the costs of raising the collateralization rate, which are financed by the lenders.

We extend our numerical example from above to characterize the solution to this problem. We assume that $\phi(\theta)\equiv\frac{\kappa}{2}(\theta-\underline{\theta})^2$ and thus $\phi(\underline{\theta})=0$ and $\phi'(\underline{\theta})=0$. Under these assumptions, $\theta>\underline{\theta}$ if and only if the agent is credit constrained. The parameter values are unchanged from above with the new parameters taking the following values: $A_2=0.5$, $\kappa=5$, $\underline{\theta}=0.2$, and $\bar{\theta}=0.4$.

The numerical solution is reported in Figure 2.[18] Investment in the first technology behaves analogously to the previous example. Firms with very few internal funds lease all their capital in that technology, firms in an intermediate range start to

[18]The availability of the second technology raises the market clearing interest rate $R$ to 19.6%.

substitute toward owned capital, and firms above a certain threshold own all of their capital. Since firms own the capital in the second technology and all firms invest in it, no firm leases all its capital (see the middle left panel of Figure 2). Moreover, firms with few internal funds (i.e., more credit constrained firms) take out loans which allow for higher leverage by making a larger fraction of capital collateralizable (see the bottom left panel of Figure 2). These loans are of course also more expensive, i.e., have a higher interest rate $R(\theta)$. But such loans are beneficial for credit constrained firms since they enable them to borrow more. Thus, the ratio of debt to assets is decreasing in internal funds. Firms with few internal funds both lease more and borrow more exactly because internal funds are scarce.

# 4 Empirical Evidence

We argue that leased capital is more easily repossessed and that it hence has higher debt capacity. Our model implies that credit constrained firms, and hence small firms, should lease more. In this section we provide evidence that the fraction of capital that firms rent is considerable and significantly related to measures of financial constraints and to firm size using data from the 1992 Census of Manufactures and Compustat. We find that firms which are smaller, pay lower dividends (relative to assets), have lower cash flow (relative to assets), and have higher Tobin's $q$, lease a larger fraction of their capital. This is true both for capital overall as well as separately for "buildings & other structures" and, to a lesser extent, for "machinery & equipment." We control for two alternative explanations, namely the tax reasons for leasing and the explanation that leased capital is more easily redeployed and hence more flexible. The findings seem largely robust to controlling for these alternative explanations and we find at best limited support for these alternatives.

## 4.1 Data

The two main data sources that we use are the 1992 Census of Manufactures micro data and Compustat. The Census of Manufactures (CM) is a survey of manufacturing plants conducted every five years. We aggregate the plant level data to the firm level and restrict our sample to firms which have at least one plant in the Annual

Survey of Manufactures (ASM).[19] The main data item from the CM that we use is "total rental payments," which is defined as "rental payments ... for use of such fixed assets as buildings, structures, and equipment." There are specific instructions regarding the treatment of leases which imply that payments on operating leases are included in this item while capital leases (as defined by the accounting rules) are excluded (and instead treated as if the capital was owned). Thus, total rental payments includes only true leases, which benefit from the preferential treatment in bankruptcy discussed above. The primary aim of the question on rental payments is to improve the measurement of the amount of capital deployed in each industry in order to improve the measurement of industry productivity. In addition, we have data for "buildings & other structures" and "machinery & equipment" separately on rental payments, as well as on end of year assets, depreciation, and capital expenditures on new and used capital. Our data is unique in providing rental payments data for smaller firms than available in Compustat and in providing data separately for structures and equipment. Finally, we have data on the number of employees and total value of shipments.

To investigate the relationship between the fraction of capital which is rented and financial variables we merge the Census data with Compustat using a Census-Compustat bridge file. The definitions and descriptive statistics of the Compustat variables that we use are summarized in Table 5.[20]

## 4.2 Evidence on Leased Capital

We start by studying the fraction of capital which is rented as a function of size using Census data only. The benefit of using Census data only is that we are able to study the role of leasing across firms of all sizes, including very small firms, whereas the merged Census-Compustat data includes only publicly traded and hence much larger firms. The cost of using Census data only is that the only measure of the extent to which a firm is constrained is the size of the firm itself and we do not have explicit

[19] The ASM is a rotating panel of plants consisting of all large plants (with 250 employees or more) as well as a sample of smaller plants. The sample is redrawn every five years and the panel starts two years after a CM, that is, in 1989 for plants in our sample. We restrict our sample in this way to ensure data quality.

[20] In addition to Compustat variables, we use the estimates of the marginal tax rate before interest expense constructed by John Graham (see, e.g., Graham, Lemmon, and Schallheim (1998)). We thank John Graham for kindly providing us with these estimates.

financial variables as in the merged data.

We use two measures of the fraction of capital which is rented. The first measure is the ratio of rental payments to the sum of rental payments plus an estimate of the user cost of owned capital. We estimate the user cost of owned capital as the sum of the estimated interest rate times the amount of owned capital plus depreciation. We use assets and depreciation from the Census data. We estimate the interest rate using the predicted values from a regression of the reported average interest rate on short term borrowings (Compustat Item 105) on assets from Census data. We run this regression on the merged data and then use the estimated coefficients to predict interest rates for all firms in our data. The second measure is the ratio of rental payments to the sum of rental payments plus capital expenditures. The denominator is hence the total cash expenditures on rent and investment. This "cash flow" measure of the fraction of capital leased has the advantage that it involves neither asset size nor Compustat data directly. We will focus on the first measure, but will report some results for the second measure for this reason.

Table 4 reports the average of these two measures across asset deciles in our data. In terms of the first measure, firms in the smallest decile rent more than 46% of their capital, whereas firms in the largest decile rent about 11% of capital on average, and the fraction rented is monotonically decreasing across size deciles. This is true for structures and equipment separately as well. Figure 3 shows the very strong relationship with size that emerges from the data graphically. The second measure behaves quite similarly. Leased capital is thus important for all firms, but is of particular importance for small firms. Indeed, it may be the most important source of external financing for very small firms. The fraction of capital leased is much higher for structures than for equipment. We would expect this given our model for two reasons: First, the moral hazard problem with respect to careful use and maintenance might be more severe for equipment and hence preclude leasing for some types of equipment. Second, since equipment on average depreciates faster, differences in the ability to repossess may be somewhat harder to detect, since the user cost of the first period is a larger fraction of the price.[21] As a robustness check, we scale the rental payments also by the number of employees and by the total value of shipments and obtain similar results (see again Table 4). Moreover, we compute the fraction of

[21] For example, if the depreciation rate were 100%, one would have to pay for the one period user cost of the equipment only even when buying (and not just when leasing the equipment), and there would be no difference.

capital expenditures on used capital (i.e., used capital expenditures relative to total capital expenditures) which also decreases strongly across asset deciles. As Eisfeldt and Rampini (2005b) argue, the fraction of capital expenditures on used capital may be an indicator of a firm's financial constraints. Thus, this can be taken as further evidence that these small firms are indeed credit constrained or, perhaps, simply as independent evidence confirming the previous finding. To summarize, we find that the fraction of capital rented decreases as the size of the firm increases and this relationship seems quantitatively important.

To study the relationship between the fraction of capital which is rented and measures of financial constraints we run regressions of our two measures as dependent variables on financial variables in the merged Census-Compustat data. The results for regressions using capital overall are reported in Table 6. Panel A reports the results for the first measure, rental payments to total cost of capital services, and Panel B the results for the second measure, rental payments to sum of rental payments and capital expenditures. Note that all regressions include industry dummies at the two digit SIC code level, which are not reported. Thus, industry effects are accounted for. We estimate the relationship with OLS, but the results are similar when estimated with a Tobit regression accounting for left-censoring.[22]

The financial variables that we use are dividends (relative to assets), long-term debt (relative to assets), cash flow (relative to assets), Tobin's $q$, and cash (relative to assets), in addition to size (the logarithm of assets). We expect to find negative coefficients on size, dividends, cash flow, and cash, and positive coefficients on debt and $q$. Columns 1-5 report the results for size and each of the financial variables individually. There is clearly a highly significant relationship with size as expected from the evidence across deciles above. In terms of the financial variables, higher dividends reduce the fraction rented significantly and so does higher cash flow. The other financial variables are not significant and while $q$ has the predicted sign, long-term debt and cash do not. Thus, we do not find support for the "leasing puzzle" when controlling for industry and firm size. One reason why the cash variable may be problematic in this context is that leasing contracts at times require the lessee to hold minimum cash balances to cover lease payments.[23] When all six variables

[22]Standard errors are robust to heteroscedasticity, but results are similar when clustering at the industry level is allowed for.

[23]In our model, lease payments are paid at time 0, which is actually somewhat similar to having to hold the lease payment in cash.

are included (column 6), the results are similar with $q$ now also significant with the predicted sign. Thus, financial variables have a significant relation to the fraction of capital leased. The financial variables are also quantitatively important with a standard deviation increase in size, dividends, and cash flow reducing the fraction rented by approximately 3%, 2%, and 1%, respectively. Compared to a median fraction of rented capital of 12% this seems considerable.

To control for the tax reasons for leasing we include a measure of the average tax rate and dummies for small and large tax loss carry forwards in the regression (column 7) and, alternatively, an estimate of the marginal tax rate before financing (column 8).[24] The tax argument typically predicts that it is beneficial for low tax rate firms to lease and hence we would expect a negative coefficient on the tax rate variables and a positive coefficient on the tax loss dummies. None of the tax variables turn out to be significant here and three out of four estimates do not have the predicted sign. Thus, the support for the tax explanation is rather limited in our data. More importantly for our purposes, controlling for taxes does not significantly alter our results regarding the significance of the financial variables. Controlling for the marginal tax rate before financing actually strengthens our results somewhat: the coefficients on dividends and cash flow increase (in absolute value) and the cash variable has the predicted sign, although the estimate is still not significant.

One might also argue that in practice firms lease capital when they need flexibility, because leased capital may be more easily redeployed than owned capital and may hence be more reversible. This would suggest that measures of firm level variability should raise the fraction of capital leased. We also control for firm age, since young firms in particular might require flexibility, although firm age may alternatively be interpreted as a measure of financial constraints. The results are in column 9 and 10. While these two variables decrease the significance and magnitude of the size variable somewhat, they do not otherwise affect our estimates considerably. Moreover, the flexibility explanation does not have much empirical support in our data, since the coefficient estimate on the standard deviation of sales growth is significantly negative. It is worth noting however that the argument that leasing is more flexible than buying is not so clear cut, since leasing puts restrictions on how the asset can be deployed or altered by the user, and it may at times be easier to sell an asset than to renegotiate a lease. The age variable is also significant and negative, which is consistent with the flexibility argument, but might, in light of the estimate of the effect of variability,

[24]For a detailed description of the variables see Table 5.

instead be evidence of credit constraints of young firms. In short, we find that size, dividends, and cash flow are significantly related to the fraction of capital rented with the predicted sign, and that this relationship is economically important and robust to controlling for tax effects as well as measures of firm variability.

Panel B of Table 6 reports the results for the alternative dependent variable, rent over rent plus capital expenditures, with quite similar results. Size, dividends, and cash flow again have the predicted sign and are significant throughout. Both long-term debt and cash now have the predicted sign, but are only marginally significant when other financial variables are included. The marginal tax rate variable now has the predicted sign, but remains insignificant.

Table 7 reports the results for structures and equipment separately. We report the results for the first dependent variable, rent to total cost of capital services, only, since the results for the second dependent variable are comparable to those reported in Panel B of Table 6 for capital overall. Broadly speaking, the results are similar to the results for capital overall, although the results are weakened somewhat, at least for equipment. Size and dividends remain important, in particular in the regressions using data on structures. Tobin's $q$ remains significant with the predicted sign for structures as well, but the results for cash are more mixed. As argued above, however, we might expect the effect of financial constraints to be harder to detect using data on equipment, since equipment typically has higher depreciation and since in addition it may not be possible to lease some types of equipment due to the severity of the moral hazard problem.

We conclude that there is a significant relationship between the fraction of capital leased or rented and financial variables, in particular dividends, cash flow, and size, consistent with the predictions of our model. This relationship is robust to controlling for several alternative explanations. When structures and equipment are considered separately, we find a similar relationship, although it may be somewhat weakened at least for equipment.

# 5 Related Literature

Several explanations for leasing have been suggested in the literature. The main focus of the finance literature is the tax reason for leasing. But it has also been suggested that leasing can increase market power, leasing can reduce adverse selection, leasing can reduce the transaction costs of redeploying capital, and that leasing may be part

of an optimal portfolio choice problem.

Following Miller and Upton (1976),[25] the finance literature has focused on the analysis of the leasing decision in a Modigliani-Miller environment, where firms are indifferent between leasing and buying, except when facing different tax rates.[26] Myers, Dill, and Bautista (1976) present a formula to evaluate the lease vs. buy decision in such an environment, which is now widely used.[27] They show that differences in the tax rates across firms imply differences in the discount rate which may make it beneficial for low tax rate (and hence high discount rate) firms to lease, since the incremental cash flows of leasing are often positive early on and negative later on. Interestingly, the net gains to leasing decline as the fraction that firms can finance with debt when they buy declines, since the wedge between the discount rates declines. In contrast, in our model the higher debt capacity of leasing increases the benefits of leasing. Graham, Lemmon, and Schallheim (1998) provide evidence supporting the hypothesis that low tax rate firms lease more. They also include financial variables and find that firms with lower Altman Z-scores, negative book value of common equity, and higher variability of earnings lease more.

Ang and Peterson (1984) argue that theory suggests that debt and leases are substitutes, but empirically they find a positive relationship between the lease to book value of equity and debt to book value of equity ratio. Hence they conclude that there is a leasing puzzle. Lewis and Schallheim (1992) provide a resolution of the puzzle in an environment where leasing is motivated by tax considerations. They argue that leasing allows the transfer of tax shields which increases the benefits of debt financing for the lessee.

The importance of nontax incentives for leasing is discussed by Smith and Wakeman (1985). They provide an informal list of characteristics of users and lessors which influence the leasing decision and explain many contractual provisions in leasing contracts. They mention that "it is simpler for a lessor to regain physical possession of a leased asset either prior to or after the declaration of bankruptcy than for a secured debt holder to acquire the pledged asset" (p. 899), but do not include the repossession advantage in their concluding list of eight nontax incentives to lease. The impact of financing constraints on the leasing decision is also the focus of two em-

[25] See also Lewellen, Long, and McConnell (1976).

[26] Miller and Upton (1976) do however mention that there are differences between lessors and secured lenders in the ability to enforce their claim in two footnotes.

[27] See also McConnell and Schallheim (1983), who study the value of options embedded in lease contracts.

pirical studies. Krishnan and Moyer (1994) study capital leases and find that lessee firms have lower retained earnings relative to total assets, higher growth rates, lower coverage ratios, higher debt ratios, higher operating risk, and lower Altman Z-scores (i.e., higher bankruptcy potential) that non-lessee firms. Sharpe and Nguyen (1995) study both the capital lease share and the operating lease share of total capital costs and find that in particular the operating lease share is significantly higher for firms which pay no dividend, have lower earnings to sales, have lower credit ratings, and are smaller. The results in both these studies are broadly consistent with our findings and our model provides an explanation for the finding that it is specifically operating leases which are most affected by financial constraints. Operating leases are almost always true leases from the vantage point of the law and hence enjoy a repossession advantage not shared by capital leases.

Sale-and-leaseback transactions are modeled by Kim, Lewellen, and McConnell (1978) as a way for stockholders to expropriate existing bondholders by issuing higher priority claims. In contrast, our theory suggests that sale-and-leaseback transactions may be an efficient, albeit costly, way to raise additional external funds. Our theory also provides a different interpretation of the results in the empirical literature on sale-and-leaseback transactions. Slovin, Sushka, and Poloncheck (1990) find that such transactions are associated with positive abnormal returns to the lessees and conclude that this is due to a reduction in the present value of expected taxes induced by the transactions. However, this would also be consistent with the idea that a financially constrained firm used the sale-and-leaseback transaction to free up capital to take advantage of an investment opportunity, as the quote in footnote 5 suggests. Ezzell and Vora (2001) also find positive abnormal returns associated with sale-and-leaseback transactions and moreover show that abnormal returns are higher for firms which do not pay dividends and which have lower interest coverage ratios, i.e., financially constrained firms. From the vantage point of our theory this suggests that the ability to raise additional external funds through sale-and-leaseback transactions is particularly valuable for more credit constrained firms.

Several additional explanations for leasing have been suggested in the literature. Leasing may allow a monopolist to extend his market power. Coase (1972) and Bulow (1986) argue that a durable goods monopolist may choose to lease goods to overcome the time inconsistency problem. Relatedly, Waldman (1997) and Hendel and Lizzeri (1999) argue that a durable goods monopolist may choose to lease in order

to reduce the competition from used goods markets.[28] The role of leasing in reducing adverse selection in the secondary market for durable goods has been considered by Hendel and Lizzeri (2002) and Johnson and Waldman (2003).[29] Gilligan (2004) provides related empirical evidence. Leasing can also economize on transactions costs. Flath (1980) suggests that short-term leasing is valuable because it economizes on the cost of transferring ownership, including the costs of assuring quality. Eisfeldt and Rampini (2005a) study capital reallocation and Gavazza (2005) argues that lessors have a transaction cost advantage in redeploying capital and hence are capital reallocation intermediaries.

The rent vs. buy decision has been extensively studied in the housing literature, typically as a portfolio choice problem.[30] Henderson and Ioannides (1983) consider a model where there is a moral hazard problem in utilization of rented housing which makes owning beneficial and distorts the portfolio choice problem. They assume that housing consumption is not an inferior good and find the counterfactual result that "higher wealth people will be renters" (p. 107) because their consumption demand exceeds their portfolio demand. Moreover, they consider a borrowing constraint, where agents cannot borrow against future income for current consumption, and find that this financial constraint cannot alter their general findings. Our model applied to the rent vs. buy decision for housing would in contrast provide a simple explanation for why lower wealth, credit constrained households choose to rent. The effects of down payment requirements on the rent vs. buy decision have been studied, for example, by Artle and Varaiya (1978), Stein (1995), and Engelhardt (1996). The models in this literature typically consider the choice of either renting or buying, whereas in our model agents can lease any fraction of their capital, i.e., the leasing decision is a convex problem.

The literature on trade credit provides arguments which may be the most closely related to our explanation for leasing. Frank and Maksimovic (1998) focus explicitly on the value of collateral in repossession and argue that a supplier is better able to capture the value of a repossessed input than a lender. Relatedly, Burkart and

[28] See also Anderson and Ginsburgh (1994) for a related argument.

[29] See also Hendel, Lizzeri, and Siniscalchi (2005), who study optimal rental contracts which completely eliminate the adverse selection problem, and Johnson and Waldman (2004), who study leasing in a model with both adverse selection and moral hazard regarding maintenance.

[30] Risk sharing concern have also been considered by Flath (1980) and Wolfson (1985). For a recent study of the rent vs. buy decision as a pure portfolio choice problem see Sinai and Souleles (2005), who consider a model with both rent and price risk, and the papers cited therein.

Ellingsen (2004) argue that it may be easier to keep a borrower from diverting inputs than from diverting cash and that hence a supplier may be able to lend more than a lender. Petersen and Rajan (1997) survey various theories of trade credit and provide evidence that small and credit constrained firms use more trade credit.[31]

# 6 Conclusions

We argue that ownership affects the ability to repossess: It is easier for a lessor to repossess a leased asset from the lessee than for a secured lender to recover or foreclose on collateral. The repossession advantage of leasing in turn implies that a lessor is able to extend more credit against a leased asset than a secured lender would be. Thus, leased capital has a higher debt capacity and leasing "preserves capital." However, allocating ownership with the agent who provides financing to facilitate repossession has a cost since it separates ownership and control. For agents who are sufficiently constrained, the benefit of the higher debt capacity of leased capital outweighs the costs due to the agency problem induced by the separation of ownership and control. Agents who are sufficiently constrained will hence lease capital, whereas agents who are less constrained or unconstrained will own all their capital.

The law in the U.S., in particular the U.S. bankruptcy code, implies that a lessor has specific advantages over a secured lender in terms of the ability to regain control of an asset. However, we believe that it is probably the case in most legal environments that retaining ownership facilitates regaining control of an asset and thus enables increased implicit credit extension. Indeed, this advantage may be particularly important in environments with weak legal enforcement and thus leasing or renting capital may be more prevalent there. This is not a foregone conclusion, though, and it is an empirical question how weak legal environments affect the relative merits of leasing and secured lending. One question is, for example, whether weak legal enforcement makes it relatively easier for a landlord to regain possession of the property than for a lender to foreclose on a mortgage. Similarly, it would be interesting to understand the relative prevalence of leasing vs. secured lending in economic history. This might furthermore shed light on the importance of the

[31] See also Brennan, Maksimovic, and Zechner (1988), who show that suppliers with market power may offer trade credit to be able to price discriminate, and Burkart, Ellingsen, and Giannetti (2005) for a recent survey of theories and empirical evidence as well as the papers cited therein.

repossession and debt capacity incentives for leasing vis-à-vis the tax incentives.

The importance of financing constraints for leasing has implications for several key aspects of corporate finance. First, the fraction of the capital stock which is leased, in particular under operating leases, can be used as a revealed preference indicator of the extent to which a firm is financially constrained. This may be an important ingredient for indices of credit constraints and the appropriate data is available from Compustat. Second, in measuring leverage considering the implicit debt due to leasing may be critical since it is the more constrained firms which lease more. Third, in studies of firm investment, and specifically in studies of the effect of financing constraints on firm investment, attention should not be limited to capital expenditures but leased capital should also be considered. For example, ignoring leasing when measuring investment cash flow sensitivities to assess the effect of credit constraints may be misleading since credit constrained firms lease more capital and thus the investment cash flow sensitivities are mismeasured and are likely overstated. Finally, from a macroeconomic perspective, the fact that small firms lease about half their capital suggests that understanding leasing is critical for understanding the behavior of small firms, which have been argued to play a key role in determining business cycle fluctuations and economic growth.

# Appendix A: Contracting Environment

In this appendix we describe a contracting environment explicitly in which leased capital depreciates faster than owned capital at the optimal contract, and which hence endogenizes this property that we have so far assumed.

Consider again the economy from section 3.1. Suppose as before that if the financier retains ownership, i.e., if capital is leased, the financier can fully repossess it, whereas if the user is the owner, the financier can only repossess fraction $\theta$. Assume moreover that the financier cannot commit not to repossess capital to the extent possible and that the user of capital cannot commit to make additional payments. In addition, suppose there is a moral hazard problem with respect to careful use and maintenance. After production occurs, the user has to maintain the capital at a disutility cost of $\varepsilon$ per unity of capital. If capital is maintained, then it will depreciate at rate $\delta$, whereas otherwise it will depreciate at rate $\delta_l > \delta$.

The return on maintenance to the agent varies depending on the type of the capital. Since leased capital gets fully repossessed by the financier, the return on maintenance to the agent is zero and hence he will not maintain the leased capital. In contrast, the return on maintenance for internally financed capital is $\delta_l - \delta$ per unit of capital and for capital financed with a secured loan $(1-\theta)(\delta_l - \delta)$. Thus, as long as $\varepsilon$ is not too large, the user will maintain both internally financed capital and capital financed with a secured loan, i.e, all owned capital. Leased capital then depreciates at rate $\delta_l$ whereas owned capital depreciates at rate $\delta$. Taking the limit as $\varepsilon$ goes to zero we obtain exactly the environment as assumed in section 3.1.

This highlights the critical assumption, namely that the lessor cannot commit to reward the user for his careful use or maintenance effort, or at least not perfectly, which means that the user will not use the capital with care or maintain it well. This results in higher depreciation which is reflected in the leasing rate.

# Appendix B: Proof

**Proof of Proposition 1.** By the Theorem of the Maximum, the maximizers are continuous in $e$ since the objective is continuous and the constraint set convex. Moreover, the first order conditions are necessary and sufficient. The first order conditions can be written as $u'(c_0) = \mu_0$, $\beta u'(c_1) = \mu_1$, and

$$\begin{aligned} \mu_0(1 - R^{-1}\theta(1-\delta)) &= \mu_1(\alpha k^{\alpha-1} + (1-\theta)(1-\delta)) + \nu_b && (1)\\ \mu_0(1 - R^{-1}(1-\delta_l)) &= \mu_1(\alpha k^{\alpha-1}) + \nu_l && (2)\\ \mu_0 R^{-1} &= \mu_1 + \lambda && (3) \end{aligned}$$

where $\mu_0$ and $\mu_1$ are the multipliers on the budget constraint at time 0 and 1, respectively, $\nu_b$ and $\nu_l$ are the multipliers on the non-negativity constraints of $i_b$ and $i_l$, respectively, and $\lambda$ is the multiplier on the borrowing constraint.

Suppose that the credit constraint does not bind, i.e., $\lambda = 0$. Then (1-3) imply that $\delta_l - \delta = \frac{\nu_l - \nu_b}{\mu_1}$ and thus $\nu_l > 0$ and $\nu_b = 0$. But then $\bar{\bar{k}} \equiv \left(\frac{R-(1-\delta)}{\alpha}\right)^{\frac{1}{\alpha-1}}$.

Suppose instead that $\nu_l = \nu_b = 0$. Then (1-2) uniquely determine $k$ which equals $\bar{k} \equiv \left(\frac{1}{\alpha}\frac{(1-\theta)(1-\delta)(R-(1-\delta_l))}{(1-\theta)(1-\delta)-(\delta_l-\delta)}\right)^{\frac{1}{\alpha-1}} < \left(\frac{R-(1-\delta_l)}{\alpha}\right)^{\frac{1}{\alpha-1}} < \bar{\bar{k}}$.

Define the marginal rate of transformation for leased capital as $\mathrm{MRT}_l(k) \equiv \frac{\alpha k^{\alpha-1}}{1-R^{-1}(1-\delta_l)}$ and for owned capital as $\mathrm{MRT}_b(k) \equiv \frac{\alpha k^{\alpha-1}+(1-\theta)(1-\delta)}{1-R^{-1}\theta(1-\delta)}$. Note that $\left|\frac{\partial}{\partial k}\mathrm{MRT}_l(k)\right| > \left|\frac{\partial}{\partial k}\mathrm{MRT}_b(k)\right|$ and $\mathrm{MRT}_l(\bar{k}) = \mathrm{MRT}_b(\bar{k})$. Thus, for $k < \bar{k}$ the agent leases all his capital, since $\mathrm{MRT}_l(k) > \mathrm{MRT}_b(k)$, whereas for $k > \bar{k}$ the agent owns all his capital, since the inequality is reversed. Moreover, since $k(e)$ is (at least weakly) increasing in $e$ (which can be shown by total differentiation for the range where $\nu_b > 0$ and for the range where $\nu_l > 0$ and $\lambda > 0$), agents with low internal funds ($e \leq \bar{e}_l$) invest in leased capital only, agents in an intermediate range ($\bar{e}_l < e < \bar{e}_b$) keep capital at $\bar{k}$ and gradually substitute to owned capital, agents with $\bar{e}_b < e \leq \bar{\bar{e}}$ invest exclusively in owned capital and invest an increasing amount, and agents with $e > \bar{\bar{e}}$ buy an amount $\bar{\bar{k}}$ of capital. The cutoff levels $\bar{e}_l$, $\bar{e}_b$, and $\bar{\bar{e}}$ are implicitly defined by

$$\frac{u'(\bar{e}_l - (1 - R^{-1}(1-\delta_l))\bar{k})}{\beta u'(\bar{k}^\alpha)} = \frac{u'(\bar{e}_b - (1 - R^{-1}\theta(1-\delta))\bar{k})}{\beta u'(\bar{k}^\alpha + (1-\theta)(1-\delta)\bar{k})} = \mathrm{MRT}_b(\bar{k})$$

and

$$\frac{u'(\bar{\bar{e}} - (1 - R^{-1}\theta(1-\delta))\bar{\bar{k}})}{\beta u'(\bar{\bar{k}}^\alpha + (1-\theta)(1-\delta)\bar{\bar{k}})} = R,$$

which, together with the fact that $\mathrm{MRT}_b(\bar{k}) \leq R$, imply that $\bar{e}_l < \bar{e}_b < \bar{\bar{e}}$. □

# References


Alchian, Armen, and Harold Demsetz, 1972, Production, information costs, and economic organization, *American Economic Review* 62, 777- 795

Anderson, Simon P., and Victor A. Ginsburgh, 1994, Price discrimination via second-hand markets, *European Economic Review* 38, 23-44.

Andrew, Gary M., and Dennis J. Gilstad, 2005, A generation of bias against leasing, *Journal of Equipment Lease Financing* 23 (2).

Ang, James, and Pamela P. Peterson, 1984, The leasing puzzle, *Journal of Finance* 39, 1055-1065.

Artle, Roland, and Pravin Varaiya, 1978, Life cycle consumption and home ownership, *Journal of Economic Theory* 18, 38-58.

Ayer, John D., and Michael L. Bernstein, 2002, *Bankruptcy in Practice* (American Bankruptcy Institute, Alexandria)

Ayer, John D., Michael L. Bernstein, and Jonathan Friedland, 2003, What every secured creditor (and its lawyer) should know about Chapter 11, *American Bankruptcy Institute Journal* 22 (9).

Ayer, John D., Michael L. Bernstein, and Jonathan Friedland, 2004a, Bankruptcy issues for landlords and tenants, *American Bankruptcy Institute Journal* 23 (8).

Ayer, John D., Michael L. Bernstein, and Jonathan Friedland, 2004b, Executory contracts under §365, *American Bankruptcy Institute Journal* 23 (9).

Ayotte, Kenneth M., and Stav Gaon, 2005, Asset-backed securities: Costs and benefits of "bankruptcy remoteness," Working Paper, Columbia Business School.

Brealey, Richard A., Stewart C. Myers, and Franklin Allen, 2005, *Principles of Corporate Finance*, 8th Edition (McGraw-Hill, New York).

Brennan, Michael J., Vojislav Maksimovic, and Josef Zechner, 1988, Vendor financing, *Journal of Finance* 43, 1127-1141.

Bulow, Jeremy, 1986, An economic theory of planned obsolescence, *Quarterly Journal of Economics* 101, 729749.

Burkart, Mike, and Tore Ellingsen, 2004, In-kind finance: A theory of trade credit, *American Economic Review* 94, 569-590.

Burkart, Mike, Tore Ellingsen, and Mariassunta Giannetti, 2005, What you sell is what you lend? Explaining trade credit contracts, Working Paper, Stockholm School of Economics.

Coase, R. H. 1972, Durability and monopoly, *Journal of Law and Economics* 15, 143-149.

Eisfeldt, Andrea L., and Adriano A. Rampini, 2005a, Capital reallocation and liquidity, *Journal of Monetary Economics*, forthcoming.

Eisfeldt, Andrea L., and Adriano A. Rampini, 2005b, New or used? Investment with credit constraints, Working Paper, Northwestern University.

Engelhardt, Gary V., 1996, Consumption, down payments, and liquidity constraints, *Journal of Money, Credit, and Banking* 28, 255-271.

Ezzell, John R., and Premal P. Vora, 2001, Leasing versus purchasing: Direct evidence on a corporation's motivations for leasing and consequences of leasing, *Quarterly Review of Economics and Finance* 41, 33-47.

Flath, David, 1980, The economics of short-term leasing, *Economic Inquiry* 18, 247-259.

Frank, Murray, and Vojislav Maksimovic, 1998, Trade credit, collateral, and adverse selection, Working Paper, University of British Columbia and University of Maryland.

Gavazza, Alessandro, 2005, Leasing and secondary markets: Theory and evidence from commercial aircraft, Working Paper, New York University.

Gilligan, Thomas W., 2004, Lemons and leases in the used business aircraft market, *Journal of Political Economy* 112, 1157-1180.

Graham, John R., Michael L. Lemmon, and James S. Schallheim, 1998, Debt, leases, taxes, and the endogeneity of corporate tax status, *Journal of Finance* 53, 131-162.

Hart, Oliver, and John Moore, 1994, A theory of debt based on the inalienability of human capital, *Quarterly Journal of Economics* 109, 841-879.

Hendel, Igal, and Alessandro Lizzeri, 1999, Interfering with secondary markets, *RAND Journal of Economics* 30, 1-21.

Hendel, Igal, and Alessandro Lizzeri, 2002, The role of leasing under adverse selection, *Journal of Political Economy* 110, 113-143.

Hendel, Igal, Alessandro Lizzeri, and Marciano Siniscalchi, 2005, Efficient sorting in a dynamic adverse-selection model, *Review of Economic Studies* 72, 467-497.

Henderson, J. Vernon, and Yannis M. Ioannides, 1983, A model of housing tenure choice, *American Economic Review* 73, 98-113.

Johnson, Justin P., and Michael Waldman, 2003, Leasing, lemons, and buy-backs, *RAND Journal of Economics* 34, 247-265.

Johnson, Justin P., and Michael Waldman, 2004, Leasing, lemons, and moral hazard, Working Paper, Cornell University.

Kim, E. Han, Wilbur G. Lewellen, and John J. McConnell, 1978, Sale-and-leaseback agreements and enterprise valuation, *Journal of Financial and Quantitative Analysis* 13, 871-881.

Kiyotaki, Nobuhiro, and John Moore, 1997, Credit cycles, *Journal of Political Economy* 105, 211-248.

Klein, Benjamin, Robert G. Crawford, and Armen A. Alchian, 1978, Vertical integration, appropriable rents, and the competitive contracting process, *Journal of Law and Economics* 21, 297-326.

Krishnan, V. Sivarama, and R. Charles Moyer, 1994, Bankruptcy costs and the financial leasing decision, *Financial Management* 23 (2), 31-42.

Lewellen, Wilbur G., Michael S. Long, and John J. McConnell, 1976, Asset leasing in competitive capital markets, *Journal of Finance* 31, 787-798.

Lewis, Craig, and James Schallheim, 1992, Are debt and leases substitutes? *Journal of Financial and Quantitative Analysis* 27, 497-511.

McConnell, John J., and James S. Schallheim, 1983, Valuation of Asset Leasing Contracts, *Journal of Financial Economics* 12, 237-262.

Miller, Merton, and Charles Upton, 1976, Leasing, buying, and the cost of capital services, *Journal of Finance* 31, 761-786.

Myers, Stewart C., David A. Dill, and Alberto J. Bautista, 1976, Valuation of financial lease contracts, *Journal of Finance* 31, 799-819.

Nöldeke, Georg, and Klaus M. Schmidt, 1998, Sequential investments and options to own, *RAND Journal of Economics* 29, 633-653.

Petersen, Mitchell A., and Raghuram Rajan, 1997, Trade credit: Theory and evidence, *Review of Financial Studies* 10, 661-691.

Ross, Stephen A., Randolph W. Westerfield, and Jeffrey F. Jaffe, 2002, *Corporate Finance*, 6th Edition (McGraw-Hill, New York).

Schallheim, James S., 1994, *Lease or Buy? Principles of Sound Decision Making* (Harvard Business School Press, Boston).

Sharpe, Steven A., and Hien H. Nguyen, 1995, Capital market imperfections and the incentive to lease, *Journal of Financial Economics* 39, 271-294.

Sinai, Todd, and Nicholas S. Souleles, 2005, Owner-occupied housing as a hedge against rent risk, *Quarterly Journal of Economics* 120, 763-789.

Slovin, Myron B., Marie E. Sushka, and John A. Poloncheck, 1990, Corporate Sale-and-Leasebacks and Shareholder Wealth, *Journal of Finance* 45, 289-299.

Smith, Clifford W., Jr., and L. MacDonald Wakeman, 1985, Determinants of corporate leasing policy, *Journal of Finance* 40, 895-908.

Stein, Jeremy, 1995, Prices and trading volume in the housing market: A model with down-payment constraints, *Quarterly Journal of Economics* 110, 379-406.

Stulz, René M., and Herb Johnson, 1985, An analysis of secured debt, *Journal of Financial Economics* 14, 501-521.

Waldman, Michael, 1997, Eliminating the market for secondhand goods: An alternative explanation for leasing, *Journal of Law and Economics* 40, 6192.

Wolfson, Mark A., 1985, Tax, inventive, and risk-sharing issues in the allocation of property rights: The generalized lease-or-buy problem, *Journal of Business* 58, 159-171.

## Table 1: Types of Leases: Law, Taxation, and Accounting

### Bankruptcy Law and Commercial Law

Bankruptcy Code, Chapter 11, §361-363, and §365; U.C.C. §1-201 (37).

| True Lease | Lease Intended as Security |
|---|---|
| · Executory contract: Contractual obligations of both parties largely remain to be performed.<br>· Lessor retains effective ownership.<br>· In Chapter 11, lessee can assume the lease (and continue to make payments) or reject the lease (and return asset). | · Lessor has merely security interest.<br>· Lessee acquires effective ownership.<br>· In Chapter 11, lease is recharacterized as secured credit and asset is subject to automatic stay which prohibits recovery of or foreclosure on collateral. |

Criteria for Security Interest Lease not subject to termination and

(1) Lease duration exceeds remaining economic life.
(2) Lessee bound to renew lease for remaining life or bound to become owner.
(3) Lessee has option to renew lease for remaining life for no additional (or nominal) consideration.
(4) Lessee has option to become owner for no additional (or nominal) consideration.

### Taxation

Revenue Procedure 2001-28.

| True Lease | Conditional Sales Contract |
|---|---|
| · Lessee expenses rental payments.<br>· Lessor treats asset as capital expenditure (with associated depreciation) and rental payments as income. | · Lease treated like term loan or installment purchase contract.<br>· Lessee treats asset as capital expenditure (with associated depreciation) and deducts implicit interest. |

Criteria for True Lease (Meeting all criteria is required. Focus is on intent.)

(1) Minimum "at risk" investment: Lessor's investment exceeds 20% at all times. Remaining life of asset exceeds 20% of economic life. Residual value of asset exceeds 20% of original value.
(2) No bargain purchase option when lease expires. Lessor has no option to sell.
(3) Limits on investments (improvements, modifications, and additions) by lessee.
(4) No lessee loans or guarantees to lessor.
(5) Profit requirement: Lessor expects profits.

### Accounting

SFAS No. 13, "Accounting for Leases."

| Operating Lease | Capital Lease |
|---|---|
| · Lease does not substantially transfer risks and benefits of ownership to lessee.<br>· Lease off balance sheet.<br>· Lessee discloses future minimum rental payments in aggregate and for each of next 5 years in footnotes. | · Lease on balance sheet.<br>· Lessee capitalizes leased asset and records corresponding debt obligation on balance sheet. |

Criteria for Capital Lease (Meeting one criterion is sufficient.)

(1) Transfer of ownership before the end of lease term without additional compensation.
(2) Bargain purchase option (option to buy at price sufficiently below value at exercise date) when lease expires.
(3) Lease term exceeds 75% of economic life.
(4) Lease payments exceed 90% of asset's value in present value.

**Table 2: Lease vs. Buy: Cash Flows**

| | Time 0 cash flow | | Time 1 cash flow | |
|---|---|---|---|---|
| | Total | Per unit | Total | Per unit |
| Buy & borrow | $-(i_b - b)$ $= -(1 - R^{-1}\theta(1-\delta))i_b$ | $-(1 - R^{-1}\theta(1-\delta))$ | $i_b(1-\delta) - Rb$ $= (1-\theta)(1-\delta)i_b$ | $(1-\theta)(1-\delta)$ |
| | | $\bigwedge$ | | $\bigvee$ |
| Lease | $-u_l i_l$ $= -(1 - R^{-1}(1-\delta_l))i_b$ | $-(1 - R^{-1}(1-\delta_l))$ | 0 | 0 |

**Table 3: Numerical Example**

Panel A: Parameter Values

| | | | | |
|---|---|---|---|---|
| Preferences | $\beta$ | $\sigma$ | | |
| | 0.96 | 2.00 | | |
| Technology | $\alpha$ | $\delta$ | $\delta_l$ | |
| | 0.33 | 0.2 | 0.4 | |
| Collateralization Rate | $\theta$ | | | |
| | 0.20 | | | |
| Distribution of Internal Funds | $e$ | | $\pi(e)$ | |
| | $[0.1 : 0.1 : 4]$ | | $[1/40, \ldots, 1/40]$ | |

Panel B: Equilibrium Implications

| | | | |
|---|---|---|---|
| Interest Rate | $R$ | | |
| | 1.107 | | |
| Cutoff Levels of Internal Funds | $\bar{e}_l$ | $\bar{e}_b$ | $\bar{\bar{e}}$ |
| | 0.680 | 0.955 | 2.655 |
| Levels of Capital | $\bar{k}$ | $\bar{\bar{k}}$ | |
| | 0.302 | 1.117 | |

## Table 4: Ratio of Rental Payments to Measures of Total Capital and Firm Size Across Asset Deciles

The table describes the ratio of rental payments to various measures of total capital and firm size across asset deciles. We use the 1992 Census of Manufactures micro data which includes data on rental payments (which includes payments made on operating leases), end of year assets, depreciation, and capital expenditures on new and used capital for both "buildings and other structures" and "machinery and equipment," as well as employment and total value of shipments. We aggregate the plant level data to firm level data and restrict the sample to firms which have at least one plant which is part of the Annual Survey of Manufactures. We use the end of year assets as our measure of size in determining the deciles. There are 37,730 observations in our data. We compute the various ratios as the average of the ratios for all firms in each size decile. We also report the lower cutoffs for each decile. The interest rate is the predicted value using coefficients estimated in a regression of the average interest rate on short-term borrowing (Compustat Item 106) on assets from Census in merged Census-Compustat data.

| Variable | 1st | 2nd | 3rd | 4th | 5th | 6th | 7th | 8th | 9th | 10th |
|---|---|---|---|---|---|---|---|---|---|---|
| Rent to Total Cost of Capital Services ($\frac{rent}{rent+r\%\times assets+depreciation}$) | | | | | | | | | | |
| Total | 46.64% | 38.18% | 32.04% | 28.62% | 27.09% | 23.21% | 20.70% | 17.61% | 14.81% | 10.65% |
| Structures | 74.76% | 69.93% | 65.01% | 61.21% | 56.68% | 51.42% | 45.18% | 39.49% | 32.87% | 23.28% |
| Equipment | 20.66% | 15.38% | 12.22% | 10.83% | 10.35% | 8.38% | 8.30% | 7.42% | 7.16% | 5.93% |
| Rent to Sum of Rent and Capital Expenditures ($\frac{rent}{rent+capital\,expenditures}$) | | | | | | | | | | |
| Total | 51.38% | 46.92% | 42.98% | 41.45% | 41.10% | 37.76% | 34.22% | 30.31% | 25.05% | 18.30% |
| Structures | 43.97% | 40.57% | 35.92% | 37.21% | 37.21% | 37.40% | 34.43% | 33.19% | 29.08% | 23.68% |
| Equipment | 25.48% | 22.03% | 20.21% | 20.08% | 19.54% | 17.58% | 17.61% | 17.65% | 17.82% | 15.05% |
| Rent to Employment ($\frac{rent}{number\,of\,empolyees}$) (in thousands) | | | | | | | | | | |
| Total | 1.986 | 2.075 | 1.857 | 1.875 | 1.925 | 1.781 | 1.675 | 1.552 | 1.445 | 1.291 |
| Structures | 1.347 | 1.387 | 1.323 | 1.314 | 1.356 | 1.252 | 1.178 | 1.046 | 0.915 | 0.678 |
| Equipment | 0.639 | 0.688 | 0.534 | 0.561 | 0.568 | 0.528 | 0.491 | 0.496 | 0.523 | 0.558 |
| Rent to Total Shipments ($\frac{rent}{total\,value\,of\,shipments}$) | | | | | | | | | | |
| Total | 2.92% | 2.63% | 2.18% | 2.18% | 2.09% | 1.65% | 1.47% | 1.35% | 1.12% | 0.75% |
| Structures | 1.87% | 1.74% | 1.51% | 1.47% | 1.37% | 1.18% | 1.05% | 0.88% | 0.74% | 0.40% |
| Equipment | 1.05% | 0.89% | 0.67% | 0.70% | 0.72% | 0.47% | 0.42% | 0.47% | 0.38% | 0.32% |
| Used Capital Expenditures to Total Capital Expenditures ($\frac{used\,capital\,expenditures}{total\,capital\,expenditures}$) | | | | | | | | | | |
| | 18.17% | 16.61% | 18.04% | 15.98% | 15.30% | 13.67% | 13.29% | 11.10% | 8.93% | 6.19% |
| Decile Cutoff (millions) | | | | | | | | | | |
| | 0 | 0.08 | 0.18 | 0.34 | 0.64 | 1.2 | 2.2 | 4.1 | 8.1 | 21 |

## Table 5: Descriptive Statistics

The table shows the descriptive statistics for the variables used in the regressions of the fraction of capital services rented on various financial and control variables. Data is micro data from a cross section of manufacturing plants from the 1992 Census of Manufactures for the dependent variable (aggregated to the firm level), firm age, and the industry dummies, and from Compustat for financial and tax variables and the standard deviation of sales growth. See Table 4 for the details of the construction of the dependent variables using Census data. Assets are Item 6 (Assets - Total/Liabilities and Stockholders' Equity - Total); dividends are Item 21 (Dividends - Common) plus (where available) Item 19 (Dividends - Preferred); long-term debt is Item 9 (Long-Term Debt - Total); cash flow is Item 18 (Income Before Extraordinary Items) plus Item 14 (Depreciation and Amortization); Tobin's $q$ is Item 6 plus Item 24 (Price - Close) times Item 25 (Common Shares Outstanding) minus Item 60 (Common Equity - Total) minus Item 74 (Deferred Taxes - Balance Sheet) all divided by Item 6; cash is Item 1 (Cash and Short-Term Investments). The average tax rate is Item 16 (Income Taxes) divided by the sum of Item 16 and Item 18, zero if Item 16 is negative, and one if Item 16 is positive and Item 18 negative. The marginal tax rate is the before interest expense marginal tax rate constructed by John Graham (see, e.g., Graham, Lemmon, and Schallheim (1998)). The small (large) tax loss dummy is an indicator variable which is one when Item 52 (Net Operating Loss Carry Forward) is positive and smaller (larger) than the sum of Item 18, Item 14, Item 16, and Item 15 (Interest Expense). The firm age variable is the age of the firm according to Census data. The standard deviation of sales growth is computed using the logarithmic growth rates of Item 12 (Net Sales) using data for years up to 1992. The industry dummies are the industry of the largest plant of a firm measured by the value of shipments.

| Dependent Variables | | Observations | Mean | Std. Dev. | Median |
|---|---|---|---|---|---|
| $\frac{\text{rental pmts.}}{\text{rental pmts.} + r\%\times\text{assets} + \text{depr.}}$ | Overall | 1649 | 16.35% | 15.74% | 12% |
| | Equipment | 1649 | 7.86% | 10.12% | 4.5% |
| | Structures | 1637 | 33.77% | 28.89% | 25% |
| $\frac{\text{rental pmts.}}{\text{rental pmts.} + \text{cap. ex.}}$ | Overall | 1625 | 24.01% | 21.30% | 19% |
| | Equipment | 1366 | 17.09% | 21.23% | 8.8% |
| | Structures | 1317 | 35.66% | 32.03% | 25% |
| Independent Variables | | | | | |
| log(assets) | | 1649 | 5.26 | 2.03 | 5.1 |
| $\frac{\text{dividends}}{\text{assets}}$ | | 1649 | 1.28% | 2.00% | 0.40% |
| $\frac{\text{long-term debt}}{\text{assets}}$ | | 1649 | 19.15% | 17.95% | 15% |
| $\frac{\text{cash flow}}{\text{assets}}$ | | 1637 | 6.27% | 11.99% | 8.3% |
| $q$ | | 1507 | 1.67 | 1.11 | 1.30 |
| $\frac{\text{cash}}{\text{assets}}$ | | 1649 | 10.40% | 12.86% | 5.2% |
| Average tax rate | | 1648 | 33.73% | 26.41% | 36% |
| Marginal tax rate | | 1364 | 30.17% | 7.85% | 34% |
| Small tax loss dummy | | 1649 | 0.10 | 0.31 | 0 |
| Large tax loss dummy | | 1649 | 0.19 | 0.39 | 0 |
| Firm age | | 1062 | 13.91 | 4.07 | 16 |
| Std. dev. sales growth | | 1587 | 35.87% | 41.06% | 21% |

## Table 6: Regression Results: Fraction of Capital Services Rented for Capital Overall

The table shows the coefficients of regressions of two measures of the fraction of capital services rented for capital overall on various financial and control variables (controlling for industry dummies at the two digit SIC code level). Heteroscedasticity corrected standard errors are in parenthesis. Data is micro data from a cross section of firms from the 1992 Census of Manufactures for the dependent variables, firm age, and the industry dummies, and from Compustat for financial variables, tax variables, and the standard deviation of sales growth. For a detailed definition of the variables see the description in Table 5. Statistical significance at the 1%, 5%, and 10% level is indicated by $^{***}$, $^{**}$, and $^{*}$, respectively.

Panel A: Dependent Variable: Rental Payments / (Rental Payments + $r$% × Assets + Depreciation)

| Regression | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| log(assets) | -0.0131*** | -0.0148*** | -0.0146*** | -0.0150*** | -0.0145*** | -0.0123*** | -0.0120*** | -0.0103*** | -0.0060* | -0.0052 |
| | (0.0022) | (0.0021) | (0.0021) | (0.0022) | (0.0021) | (0.0024) | (0.0025) | (0.0025) | (0.0031) | (0.0034) |
| $\frac{\text{dividends}}{\text{assets}}$ | -0.8405*** | | | | | -0.9029*** | -0.8879*** | -1.2155*** | -0.8451*** | -1.1576*** |
| | (0.2196) | | | | | (0.2583) | (0.2574) | (0.2155) | (0.3198) | (0.2759) |
| $\frac{\text{long-term debt}}{\text{assets}}$ | | -0.0050 | | | | -0.0051 | -0.0050 | -0.0311 | 0.0147 | 0.0128 |
| | | (0.0207) | | | | (0.0260) | (0.0260) | (0.0277) | (0.0306) | (0.0337) |
| $\frac{\text{cash flow}}{\text{assets}}$ | | | -0.0891** | | | -0.0970*** | -0.0770* | -0.1546*** | -0.1059* | -0.1515** |
| | | | (0.0370) | | | (0.0372) | (0.0402) | (0.0515) | (0.0643) | (0.0758) |
| $q$ | | | | 0.0056 | | 0.0104*** | 0.0102*** | 0.0127*** | 0.0110** | 0.0134** |
| | | | | (0.0035) | | (0.0037) | (0.0037) | (0.0045) | (0.0055) | (0.0059) |
| $\frac{\text{cash}}{\text{assets}}$ | | | | | 0.0479 | 0.0134 | 0.0139 | -0.0132 | 0.0182 | -0.0123 |
| | | | | | (0.0342) | (0.0368) | (0.0368) | (0.0418) | (0.0546) | (0.0543) |
| Avg. tax rate | | | | | | | 0.0123 | | | |
| | | | | | | | (0.0155) | | | |
| Mrg. tax rate | | | | | | | | 0.0697 | | 0.1254 |
| | | | | | | | | (0.0669) | | (0.0865) |
| Small tax loss | | | | | | | -0.0045 | | | |
| | | | | | | | (0.0116) | | | |
| Large tax loss | | | | | | | 0.0162 | | | |
| | | | | | | | (0.0118) | | | |
| Firm age | | | | | | | | | -0.0029** | -0.0028* |
| | | | | | | | | | (0.0014) | (0.0015) |
| $\sigma$(sales growth) | | | | | | | | | -0.0197** | -0.0199** |
| | | | | | | | | | (0.0090) | (0.0100) |
| $adj.R^2$ | 13.78% | 12.76% | 13.41% | 12.61% | 12.90% | 14.40% | 14.40% | 13.66% | 13.92% | 13.26% |
| Observations | 1649 | 1649 | 1637 | 1507 | 1649 | 1498 | 1498 | 1245 | 917 | 773 |

Panel B: Dependent Variable: Rental Payments / (Rental Payments + Capital Expenditures)

| Regression | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| log(assets) | -0.0241*** | -0.02761*** | -0.0241*** | -0.0274*** | -0.0271*** | -0.0250*** | -0.0244*** | -0.0225*** | -0.0171*** | -0.0158*** |
| | (0.0029) | (0.0029) | (0.0029) | (0.0030) | (0.0029) | (0.0033) | (0.0033) | (0.0036) | (0.0042) | (0.0046) |
| $\frac{\text{dividends}}{\text{assets}}$ | -1.1067*** | | | | | -0.7411** | -0.7030** | -0.9826*** | -0.7773** | -1.0456*** |
| | (0.2736) | | | | | (0.3044) | (0.3032) | (0.3017) | (0.3664) | (0.3830) |
| $\frac{\text{long-term debt}}{\text{assets}}$ | | 0.1023*** | | | | 0.0624* | 0.0625* | 0.0299 | 0.0396 | 0.0473 |
| | | (0.0300) | | | | (0.0374) | (0.0374) | (0.0430) | (0.0428) | (0.0497) |
| $\frac{\text{cash flow}}{\text{assets}}$ | | | -0.2428*** | | | -0.2177*** | -0.1788*** | -0.2807*** | -0.3415*** | -0.3062** |
| | | | (0.0553) | | | (0.0570) | (0.0605) | (0.0789) | (0.1104) | (0.1248) |
| $q$ | | | | -0.0146*** | | -0.0051 | -0.0054 | -0.0019 | -0.0028 | -0.0020 |
| | | | | (0.0052) | | (0.0055) | (0.0055) | (0.0060) | (0.0075) | (0.0083) |
| $\frac{\text{cash}}{\text{assets}}$ | | | | | -0.0989** | -0.0640 | -0.0616 | -0.0941* | -0.0515 | -0.0595 |
| | | | | | (0.0423) | (0.0451) | (0.0449) | (0.0529) | (0.0592) | (0.0666) |
| Avg. tax rate | | | | | | | 0.0280 | | | |
| | | | | | | | (0.0220) | | | |
| Mrg. tax rate | | | | | | | | -0.0290 | | -0.0393 |
| | | | | | | | | (0.1063) | | (0.1467) |
| Small tax loss | | | | | | | -0.0032 | | | |
| | | | | | | | (0.0161) | | | |
| Large tax loss | | | | | | | 0.0328** | | | |
| | | | | | | | (0.0168) | | | |
| Firm age | | | | | | | | | -0.0017 | -0.0026 |
| | | | | | | | | | (0.0018) | (0.0020) |
| $\sigma$(sales growth) | | | | | | | | | -0.0219* | -0.0208 |
| | | | | | | | | | (0.0131) | (0.0146) |
| $adj.R^2$ | 11.85% | 11.57% | 13.13% | 11.04% | 11.20% | 14.09% | 14.29% | 14.22% | 12.84% | 12.11% |
| Observations | 1625 | 1625 | 1614 | 1486 | 1625 | 1478 | 1478 | 1229 | 917 | 773 |

## Table 7: Regression Results: Fraction of Capital Services Rented for Structures and Equipment

The table shows the coefficients of regressions of the fraction of capital services rented for structures and equipment on various financial and control variables (controlling for industry dummies at the two digit SIC code level). Heteroscedasticity corrected standard errors are in parenthesis. Data is micro data from a cross section of firms from the 1992 Census of Manufactures for the dependent variables, firm age, and the industry dummies, and from Compustat for financial variables, tax variables, and the standard deviation of sales growth. For a detailed definition of the variables see the description in Table 5. Statistical significance at the 1%, 5%, and 10% level is indicated by ***, **, and *, respectively.

Panel A: Structures (Dependent Variable: Rental Payments / (Rental Payments + $r$% × Assets + Depreciation))

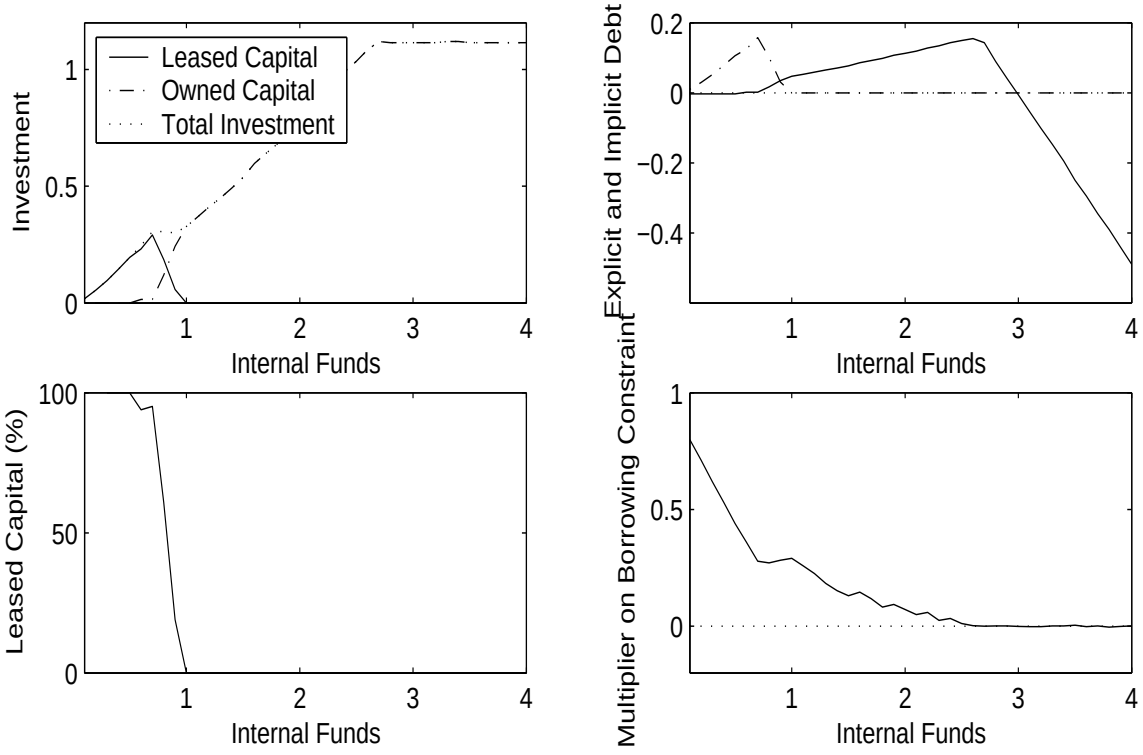
| Regression | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| log(assets) | -0.0267*** | -0.0297*** | -0.0298*** | -0.0306*** | -0.0286*** | -0.0253*** | -0.0222*** | -0.0203*** | -0.0092* | -0.0062 |
| | (0.0039) | (0.0038) | (0.0037) | (0.0040) | (0.0038) | (0.0041) | (0.0042) | (0.0044) | (0.0053) | (0.0057) |
| $\frac{\text{dividends}}{\text{assets}}$ | -1.5478*** | | | | | -1.6945*** | -1.7020*** | -2.0629*** | -2.0798*** | -2.3488*** |
| | (0.3730) | | | | | (0.4234) | (0.4219) | (0.4307) | (0.4870) | (0.4822) |
| $\frac{\text{long-term debt}}{\text{assets}}$ | | -0.0137 | | | | -0.0219 | -0.0213 | -0.0499 | -0.0161 | -0.0027 |
| | | (0.0384) | | | | (0.0461) | (0.0458) | (0.0536) | (0.0563) | (0.0650) |
| $\frac{\text{cash flow}}{\text{assets}}$ | | | -0.1617** | | | -0.1807*** | -0.1010 | -0.2711*** | -0.1476 | -0.1573 |
| | | | (0.0647) | | | (0.0674) | (0.0729) | (0.0985) | (0.1084) | (0.1328) |
| $q$ | | | | 0.0077 | | 0.0145** | 0.0145** | 0.0217*** | 0.0202** | 0.0215** |
| | | | | (0.0062) | | (0.0066) | (0.0066) | (0.0077) | (0.0093) | (0.0095) |
| $\frac{\text{cash}}{\text{assets}}$ | | | | | 0.1635*** | 0.1084 | 0.1047 | 0.0551 | 0.1544* | 0.1135 |
| | | | | | (0.0615) | (0.0667) | (0.0663) | (0.0778) | (0.0924) | (0.0957) |
| Avg. tax rate | | | | | | | -0.0330 | | | |
| | | | | | | | (0.0283) | | | |
| Mrg. tax rate | | | | | | | | 0.0048 | | 0.0772 |
| | | | | | | | | (0.1350) | | (0.1819) |
| Small tax loss | | | | | | | -0.0173 | | | |
| | | | | | | | (0.0220) | | | |
| Large tax loss | | | | | | | 0.0565*** | | | |
| | | | | | | | (0.0217) | | | |
| Firm age | | | | | | | | | -0.0057** | -0.0059** |
| | | | | | | | | | (0.0023) | (0.0026) |
| $\sigma$(sales growth) | | | | | | | | | -0.0357* | -0.0426** |
| | | | | | | | | | (0.0187) | (0.0208) |
| $adj.R^2$ | 14.39% | 13.36% | 14.37% | 13.19% | 13.84% | 15.59% | 16.02% | 14.19% | 12.99% | 12.22% |
| Observations | 1637 | 1637 | 1625 | 1496 | 1637 | 1487 | 1487 | 1235 | 915 | 769 |

Panel B: Equipment (Dependent Variable: Rental Payments / (Rental Payments + $r\%$ × Assets + Depreciation))

| Regression | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| log(assets) | -0.0050*** | -0.0059*** | -0.0059*** | -0.0061*** | -0.0058*** | -0.0057*** | -0.0061*** | -0.0055*** | -0.0057*** | -0.0057** |
| | (0.0014) | (0.0014) | (0.0014) | (0.0015) | (0.0014) | (0.0017) | (0.0017) | (0.0017) | (0.0020) | (0.0022) |
| $\frac{\text{dividends}}{\text{assets}}$ | -0.3546** | | | | | -0.3283* | -0.3062 | -0.5204*** | -0.1544 | -0.3750* |
| | (0.1500) | | | | | (0.1874) | (0.1876) | (0.1445) | (0.2312) | (0.1954) |
| $\frac{\text{long-term debt}}{\text{assets}}$ | | 0.0095 | | | | 0.0154 | 0.0152 | -0.0094 | 0.0224 | 0.0147 |
| | | (0.0134) | | | | (0.0175) | (0.0175) | (0.0175) | (0.0189) | (0.0204) |
| $\frac{\text{cash flow}}{\text{assets}}$ | | | -0.0315 | | | -0.0304 | -0.0245 | -0.0921** | -0.0705 | -0.0960* |
| | | | (0.0263) | | | (0.0274) | (0.0285) | (0.0381) | (0.0501) | (0.0562) |
| $q$ | | | | 0.0012 | | 0.0038 | 0.0037 | 0.0048 | 0.0035 | 0.0054 |
| | | | | (0.0024) | | (0.0026) | (0.0026) | (0.0032) | (0.0042) | (0.0046) |
| $\frac{\text{cash}}{\text{assets}}$ | | | | | -0.0017 | -0.0049 | -0.0034 | -0.0275 | 0.0225 | -0.0415 |
| | | | | | (0.0218) | (0.0229) | (0.0229) | (0.0244) | (0.0334) | (0.0357) |
| Avg. tax rate | | | | | | | 0.0199* | | | |
| | | | | | | | (0.0118) | | | |
| Mrg. tax rate | | | | | | | | 0.1058** | | 0.0852 |
| | | | | | | | | (0.0511) | | (0.0631) |
| Small tax loss | | | | | | | 0.0023 | | | |
| | | | | | | | (0.0076) | | | |
| Large tax loss | | | | | | | 0.0070 | | | |
| | | | | | | | (0.0082) | | | |
| Firm age | | | | | | | | | -0.0010 | -0.0014 |
| | | | | | | | | | (0.0009) | (0.0009) |
| $\sigma$(sales growth) | | | | | | | | | -0.0091 | -0.0085 |
| | | | | | | | | | (0.0059) | (0.0063) |
| $adj.R^2$ | 5.62% | 5.20% | 5.33% | 4.78% | 5.18% | 5.26% | 5.36% | 6.17% | 7.61% | 7.70% |
| Observations | 1649 | 1649 | 1637 | 1507 | 1649 | 1498 | 1498 | 1245 | 920 | 774 |

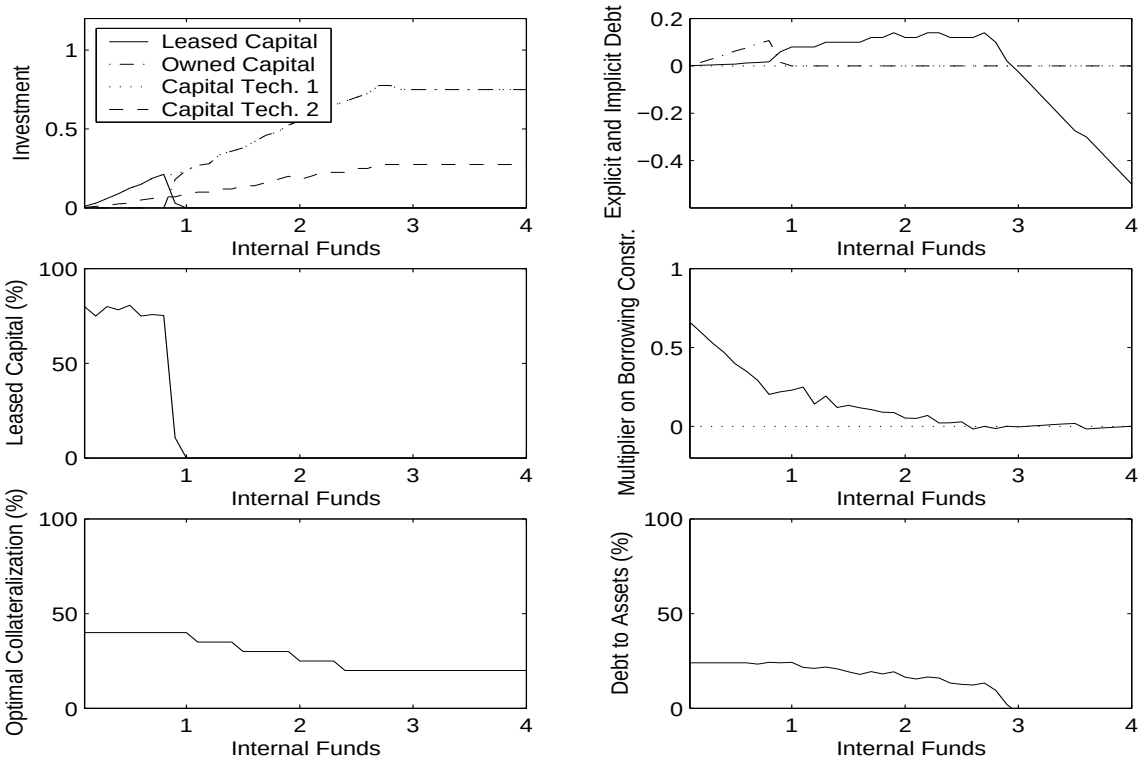
**Figure 1: Investment in Owned Capital and Leased Capital**

Top Left Panel: Investment in owned capital (dash dotted), leased capital (solid), and total investment (dotted) as a function of the amount of internal funds. Bottom Left Panel: Leased capital as percentage of total investment. Top Right Panel: Explicit debt (solid) and implicit (leasing) debt (dash dotted). Bottom Right Panel: Multiplier on the borrowing constraint $\lambda(e)$ (normalized by the marginal utility of consumption at time 0) as a function of the amount of internal funds.



## Figure 2: The Leasing Puzzle: A Resolution

Top Left Panel: Investment in owned capital (dash dotted), leased capital (solid), total investment in the first technology (dotted) and investment in the second technology (dashed) as a function of the amount of internal funds. Middle Left Panel: Leased capital as percentage of total investment. Bottom Left Panel: Optimal collateralization rate. Top Right Panel: Explicit debt (solid) and implicit (leasing) debt (dash dotted). Middle Right Panel: Multiplier on the borrowing constraint $\lambda(e)$ (normalized by the marginal utility of consumption at time 0). Bottom Right Panel: Debt as a percentage of assets.



## Figure 3: Ratio of Rental Payments to Total Payments for Capital Services Across Asset Deciles

Fraction of rental payments (including payments on operating leases) relative to total payments for capital services (sum of rental payments, interest rate times total assets, and depreciation) across asset deciles for total capital (solid), buildings and other structures (dashed), and machinery and equipment (dotted). We use the 1992 Census of Manufactures micro data. See Table 4 for a detailed description of the data construction.