The Role of Leasing in the Response of Investment to Tax Benefits

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Abstract

Obtaining capital goods through operating lease (Off-balance-sheet investment) is treated differently than purchasing of capital goods in terms of tax benefits. I model firms’ leasing behavior based on their tax status and derive the demand for the relative use of off-balance-sheet investment. I study the responsiveness of firms’ investment activity in response to tax policy, in particular, Bonus Depreciation policy in 2002, and find strong evidence that firms respond to both their own tax status and to tax policy changes. I also report that in the operating leasing market, lessors share tax benefits with lessees on average, instead of taking all the tax benefits away.

1 Introduction

A firm may directly purchase or lease assets to make use of capital services. In U.S., leasing is estimated to be 30 percent of equipment investment, according to U.S. Industrial Outlook and to Equipment Leasing Association. However, the amount of investment financed through leasing ("leased investment") has been largely ignored in public finance literature mainly because economists have believed that leased investment is already counted in the investment data when lessors purchase assets in order to lease the assets to lessees. While this is indeed the case in aggregate investment data such as the most frequently used one from Bureau of Economic Analysis, previous studies that have used disaggregate firm-level accounting data necessarily failed to take into account all types of investment activities. This is because investment information in
accounting data is taken from lessees’ balance sheets, but for the lessees, its balance sheet does not recognize off-balance-sheet leasing activities.

The question of tax responsiveness of business investment has been one of the most frequently studied topics in public finance. Aggregate real investment, however, have not proven to follow the straightforward prediction of neoclassical investment analysis.\(^1\) Consequently, economists have turned to looking at cross-sectional variation, either firm-level (i.e. different firms face different user costs of capital) or asset-level (i.e. different assets get different tax treatments) to test whether firm-level or asset-level investment are responsive to these different tax costs, with which this paper is on the same line of research. However, in most public finance literature using disaggregate accounting data, such as Cummins, Hassett, and Hubbard (1994), investment data comes from Property, Plant and Equipment account in (lessee) firms’ balance sheets, and thus fails to include off-balance-sheet investment, that is, investment made through a certain type of leasing - namely, operating lease.

The purpose of this paper is to investigate the tax responsiveness of “off-balance-sheet” investment (through operating lease) to tax status as well as to tax policy. Since decisions between purchasing and leasing has been a missing part in the tax responsiveness of business investment research, this study makes this line of research more complete, considering the significant size of leased investment. In this paper, I focus on tax treatment differences over difference financing methods, and find evidence that relative use of off-balance-sheet investment strongly responds to the firm’s tax status which is a function of corporate income tax rates, investment tax credits, and depreciation allowances. I also find that firms have responded to Bonus Depreciation policy that was introduced in 2002, by altering financing methods.\(^2\) This also suggests that lessors in the operating lease market were sharing some of tax benefits with lessees, but the result suggests that some groups of lessees may have been discriminated.

The rest of the paper is organized as follows. Section 2 presents the institutional backgrounds of leasing activities. Section 3 presents a general investment model and extends it to encompass

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\(^1\)See Hassett and Hubbard (2002), pp 1316-7.

\(^2\)By choosing “financing method,” I mean deciding between purchasing or financing throughout this paper. Debt-financed purchasing is also part of purchasing in the model developed here.
leasing, and Section 4 describes the data, and explains how to construct off-balance-sheet investment data out of accounting data. Section 5 presents the empirical results and the implications and Section 6 concludes.

2 Background: Types of Leasing

According to the Statement of Financial Accounting Standards (SFAS), a lease is categorized as either an operating lease or a capital lease. In a capital lease, the lessee is effectively borrowing cash from the lessor to purchase the asset. Therefore, when signed, the lessee’s balance sheet recognizes the capital lease as an asset as well as a debt (liability). The use of a capital lease is included in calculating the firm’s long term debt. In this sense, capital lease is equivalent to non-leasing debt. Bowman (1980) empirically showed that a capital lease has a similar negative impact on the lessee’s market risk as other non-leasing debt does.

On the other hand, in an operating lease which is the focus of this paper, the lessor is still the owner of the asset, and only the right to use the asset is transferred to the lessee. The lease payment is treated as an expense in the lessee’s income statement, so the lessee firm can keep this activity off its balance sheet. As firms in general have an incentive to reduce their debt level, they would prefer reporting their leasing activity as operating lease. Consequently, the Financial Accounting Standards Board imposed a set of strict rules on the determination of operating lease against capital lease.3

As far as tax issues are concerned, the IRS has its own categories for leasing activities - true lease and conditional-sale contracts. Using slightly different criteria than the SFAS rule, the IRS rule says that in a true lease, the lessors receive all the nominal tax subsidies including depreciation allowances from the government, whereas it is the lessees who receive the nominal benefits in a conditional-sale contract. However, an activity classified as true lease by IRS is highly likely to be classified as operating lease, and one classified as capital lease by SFAS would be classified as conditional-sale contracts. Throughout this paper, therefore, I will treat true lease

3See Appendix for detailed information on this rule.
as operating lease, as operating lease data is publicly available from accounting data. Thus, under
an operating lease, the lessor receives the nominal tax benefits from the government. Tax incidence
issue remains important for this type of leasing. While it is typically assumed that lessors “passes
on tax benefits to lessees,” it is indeed an empirical question, which will be investigated in later
section.

Another important point to note is that in this paper, I do not separate capital lease from
debt-financed direct purchase financing method, because capital lease is essentially a debt-financed
direct purchase. As explained above, a capital lease is a form of debt financing both practically
and empirically, and will be treated as part of debt in the model.

3 Model

I use a discrete time version of basic investment model and extend it to encompass different
leasing activities. In order to explicitly distinguish the model that is extended in this paper from
the basic model, I first present the baseline investment model without leasing in section 3.1, and
then the generalized model where a firm can choose between purchase and leasing is developed in
section 3.2.

3.1 A Model Only With Direct Purchase (The Baseline Model)

In this step, I assume firms can only purchase assets through equity-financing or debt-financing.
A purpose of this subsection is to present a baseline model to reproduce Hall and Jorgenson’s
(1967) user cost of capital result. The firm’s value at time \( t \) is given by

\[
V_t = \sum_{s=t}^{\infty} \frac{DIV_s}{(1+r)^{s-t}},
\]

where \( DIV_s \) is the dividend at time \( s \), and \( r \) is the interest rate. The dividends part is modeled:

\[
DIV_s = [p_s F(K_s, L_s) - w_s L_s - p_s br_s](1 - \tau) - q_s I_s
\]

\[\text{Eq. 1}\]

\[\text{Eq. 2}\]
where $K_s$ is capital at time $s$, $L_s$ labor, $b$ the maintained debt level, $p_s$ the overall price level, $F(K, L)$ production function, $w_s$ wage rate, $\tau$ corporate tax rate, and $q_s$ the after-tax unit price of capital goods. For simplicity, the before-tax price of capital goods is assumed to follow the overall price level, $p_s$, and the firm is assumed to finance $b_s$ fraction of investment through debt, either non-leasing debt or capital lease, at time $s$. Then the price of capital goods per unit is given by

$$q_s = [1 - ITC - b_s - z\tau]p_s,$$

where $ITC$ is investment tax credit, $z$ the present value of depreciation allowances per dollar investment. The firm maximizes equation (1) with respect to $L_t$, $K_{t+1}$, and $I_t$, subject to the capital accumulation formula,

$$K_{t+1} = (1 - \delta)K_t + I_t,$$

of which the shadow price is $\gamma_t$. The three first order conditions of the maximization problem,

$$\sum_{s=t}^{\infty} \frac{1}{(1 + r)^{s-t}} \{([p_s F(K_s, L_s) - w_s L_s - p_s br_s](1 - \tau) - q_s I_s) - \gamma_t(K_{t+1} - (1 - \delta)K_t - I_t)\},$$

with respect to $L_t$, $K_{t+1}$, and $I_t$ are, respectively,

$$F_L = \frac{w_t}{p_t}$$

$$(1 - \tau)F_K(K_{t+1}, L_{t+1}) = \frac{\gamma_t(1 + r) - \gamma_{t+1}(1 - \delta)}{p_{t+1}}$$

$$1 - ITC - b_s - z\tau = \frac{\gamma_t}{p_t},$$

where $K_s$ is capital at time $s$, $L_s$ labor, $b$ the maintained debt level, $p_s$ the overall price level, $F(K, L)$ production function, $w_s$ wage rate, $\tau$ corporate tax rate, and $q_s$ the after-tax unit price of capital goods. For simplicity, the before-tax price of capital goods is assumed to follow the overall price level, $p_s$, and the firm is assumed to finance $b_s$ fraction of investment through debt, either non-leasing debt or capital lease, at time $s$. Then the price of capital goods per unit is given by

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$$1 - ITC - b_s - z\tau = \frac{\gamma_t}{p_t},$$

where $K_s$ is capital at time $s$, $L_s$ labor, $b$ the maintained debt level, $p_s$ the overall price level, $F(K, L)$ production function, $w_s$ wage rate, $\tau$ corporate tax rate, and $q_s$ the after-tax unit price of capital goods. For simplicity, the before-tax price of capital goods is assumed to follow the overall price level, $p_s$, and the firm is assumed to finance $b_s$ fraction of investment through debt, either non-leasing debt or capital lease, at time $s$. Then the price of capital goods per unit is given by

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with respect to $L_t$, $K_{t+1}$, and $I_t$ are, respectively,

$$F_L = \frac{w_t}{p_t}$$

$$(1 - \tau)F_K(K_{t+1}, L_{t+1}) = \frac{\gamma_t(1 + r) - \gamma_{t+1}(1 - \delta)}{p_{t+1}}$$

$$1 - ITC - b_s - z\tau = \frac{\gamma_t}{p_t},$$

where $K_s$ is capital at time $s$, $L_s$ labor, $b$ the maintained debt level, $p_s$ the overall price level, $F(K, L)$ production function, $w_s$ wage rate, $\tau$ corporate tax rate, and $q_s$ the after-tax unit price of capital goods. For simplicity, the before-tax price of capital goods is assumed to follow the overall price level, $p_s$, and the firm is assumed to finance $b_s$ fraction of investment through debt, either non-leasing debt or capital lease, at time $s$. Then the price of capital goods per unit is given by

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$$K_{t+1} = (1 - \delta)K_t + I_t,$$

of which the shadow price is $\gamma_t$. The three first order conditions of the maximization problem,
Equation (5) represents the labor demand, and is not of this paper’s interest. Putting equation (6) and equation (7) together, I get the cost of capital formula for $K_{t+1}$:

$$F_K(K_{t+1}, L_{t+1}) = \frac{\gamma_t(1+r) - \gamma_{t+1}(1-\delta)}{p_{t+1}(1-\tau)}$$

$$= \frac{\gamma_t(1+r)}{p_t(1-\tau)p_{t+1}} - \frac{\gamma_{t+1}(1-\delta)}{p_{t+1}(1-\tau)}$$

$$= \frac{\gamma_t(1+r)\frac{1}{p_t(1-\tau)(1+\pi_t)} - \gamma_{t+1}(1-\delta)\frac{1}{p_{t+1}(1-\tau)}}{(1-\tau)}$$

$$= \frac{(r+\delta-\pi_t)(1-ITC-b_t-z\tau)}{(1-\tau)}$$

where the last equality uses the approximation of $\frac{1+r}{1+\pi_t} \approx 1+r-\pi_t$. This expression is the discrete time version of Hall and Jorgensen’s (1967) cost of capital term and called the “baseline cost of capital” in this paper.\(^6\)

### 3.2 A General Model With Leasing

In this step, I develop a generalized investment model with balance-sheet investment and off-balance-sheet investment (operating lease). Firm’s value and dividend are still given by equation (1) and equation (2). Suppose the firm chooses how much of capital goods it needs, $I_s$, and the fraction of off-balance-sheet investment at time $s$, $\alpha_s$. Then the unit price of investment is

$$q_s = [(1-\alpha_s)(1-ITC-b_s-z\tau) + \alpha_s om_s(1-\tau) + \sigma(\alpha_s)]p_s,$$

where $om_s$ is the capitalized operating lease payments, that is, net present value of the operating lease payment stream for the capital goods, per one dollar unit, delivered at time $s$. In addition, $\sigma$ is the convex adjustment cost of increasing the use of off-balance-sheet investment.\(^7\) Each firm has its own optimal level of $\alpha$ based on its financial condition and tax status. When it deviates further from its optimal level, the marginal cost of this adjustment gets larger.\(^8\)

\(^6\)Hall and Jorgensen’s (1967) original result was derived under static expectation, so $\pi_t = 0$.

\(^7\)This cost is net of benefit of the additional use of off-balance-sheet investment. As benefit is reasonably assumed to be concave (i.e. decreasing marginal benefit), this would not affect the convexity of this “net” cost.

\(^8\)Following installment adjustment cost literature, a specification would be $\sigma(\alpha) = \frac{1}{\eta}(\alpha - c)^2$, where $c$ is the optimal level.
convexity assures an interior solution for $\alpha$.\(^9\)

Note that all the lease payments are tax deductible because they are considered as expenses. The dividend at time $s$ becomes:

$$DIV_s = [p_s F(K_s, L_s) - w_s L_s - p_s br_s](1 - \tau) - [(1 - \alpha_s)(1 - ITC - b_s - z\tau) + \alpha_s om_s (1 - \tau) + \sigma(\alpha_s)] p_s I_s,$$

(10)

Again, the capital stock is accumulated as follows:

$$K_{t+1} = (1 - \delta) K_t + I_t.$$

(11)

The lessee maximizes equation (10) subject to equation (11) with respect to $K_{t+1}$, $I_t$ and $\alpha_t$, so the first order conditions are:

$$(1 - \tau) F_K(K_{t+1}, L_{t+1}) = \frac{\gamma_t (1 + r) - \gamma_{t+1} (1 - \delta)}{p_t + \delta}$$

(12)

$$[(1 - \alpha_t)(1 - ITC - b_t - z\tau) + \alpha_t om_t (1 - \tau) + \sigma(\alpha_t)] = \frac{\gamma_t}{p_t}$$

(13)

$$\sigma'(\alpha_t) = (1 - ITC - b_t - z\tau) - om_t (1 - \tau)$$

(14)

Combining equation (12) and (13), the cost of capital is derived.

$$F_K(K_{t+1}, L_{t+1}) = \frac{(r + \delta - \pi_t) [(1 - \alpha_t)(1 - ITC - b_t - z\tau) + \alpha_t om_t (1 - \tau)]}{(1 - \tau)}$$

(15)

As expected, when $\alpha$ is chosen to be zero (i.e. no operating lease), the cost of capital in this case is equal to the baseline cost of capital. In other extreme, when $\alpha$ is one, the cost of capital is just the present value of the lease payments. In order to study firms’ off-balance-sheet investment behaviors in terms of $\alpha$, the main focus is equation (14). The left hand side, $\sigma'(\alpha_t)$ is the marginal cost of relative use of off-balance-sheet investment, while the right hand side is the marginal relative cost of purchasing (balance-sheet investment) over leasing (off-balance-sheet investment) – that is, marginal benefit of off-balance-sheet investment.

\(^9\)Without this cost, $\alpha$ is either zero, one, or indeterminate.
3.3 Operating Leasing Market and Incidence Issue

Before attempting to derive empirical predictions out of equation (14), we first turn to operating lease market where the lease payments, $om_t$, are priced. Let’s consider lessor’s side. Since lessors are the ones who purchase capital goods, lessor’s cost in operating lease is similar to the case when lessee directly purchases capital goods. (i.e. section 3.1.) On the other hand, the benefit of lessor’s purchasing capital goods comes from the lease payments. Thus, the lessor’s profit is given by

$$[om_s(1 - \tau_R) - (1 - b_R - \lambda \ast (ITC + z\tau_R))]p_sI_s,$$

where $\tau_R$ is the lessor’s marginal tax rate, $b_R$ the lessor’s steady-state debt level, and $p_sI_s$ is the total cost of purchasing capital goods. Note that it is the lessor who first receives the tax savings, $ITC$ and $z$, from government, keeps $(1-\lambda)$ portion of the benefits, and passes on the rest of them to lessees. Assuming lessors’ margin of profit (per dollar investment), $c$, is time-invariant, the lease payments are priced by

$$om_s = \frac{1 - b_R - \lambda \ast (ITC + z\tau_R) + c}{1 - \tau_R}.$$

That is, if all the tax benefits are passed on to the lessee, they are reflected in the form of lower lease payments. If lessors keep all the benefits ($\lambda = 0$), the lease payments become

$$om_s = \frac{1 - b_R + c}{1 - \tau_R},$$

so that a tax reform such as bonus depreciation does not affect lease payments, so leasing behavior would not be changed. Therefore, tax incidence in operating lease market is particularly important in studying the responsiveness of leasing activities to tax policy. Unfortunately, due to data inavailability, I can only indirectly measure a bound of $\lambda$, which will be discussed in the next section.
3.4 Predictions: When Firms Use More Operating Lease?

Now combined with (17), equation (14) becomes

$$
\sigma'(\alpha_t) = (1 - \tau) \left[ \frac{1 - b_t - (ITC + z\tau)}{1 - \tau} - \frac{1 - b - \lambda * (ITC + z\tauR) + c}{1 - \tauR} \right].
$$

(18)

Let $B_t$ denote the right hand side of this equation, the marginal “tax-related” benefit of off-balance-sheet investment. Because $\sigma$ is a convex function, the first derivative of $\sigma$ is an increasing function of $\alpha$ and so is the inverse function of $\sigma'$. That is, $\alpha$ is an increasing function of $B$, which makes intuitive sense because this equation says that the relative use of off-balance-sheet investment is an increasing function of the marginal benefit from it. By inversing equation (18), we get

$$
\alpha_t = f\left( (1 - \tau) \left[ \frac{1 - b - (ITC + z\tau)}{1 - \tau} - \frac{1 - b - \lambda * (ITC + z\tauR) + c}{1 - \tauR} \right] \right),
$$

(19)

where $f$ function is the inverse function of $\sigma$, which is the convex cost function of operating lease usage. Note that $f$ is an arbitrary increasing function, so $f' > 0$. Equation (19) is the demand equation for the relative use of off-balance-sheet investment. Note that there is no term for capital good price, interest rate, or the shadow price of investment (i.e. $q$) in this equation. This is because the focus is on the relative use of one type of financing methods for capital service over the other, and it is assumed that the types of capital goods for which firms switches financing methods are the same.\(^{10}\) It is also assumed that, for simplicity, there is no adjustment cost (for installment) in this model. However, even though I assumed installment adjustment costs exist, it would not complicate this simple relationship, because this kind of installment costs occur regardless of financing methods, so the demand for the relative use of one financing method, controlling for the level of new capital goods delivered, should be independent of adjustment costs.

Now let’s turn to parameters that can affect the demand for the relative use of off-balance-sheet investment. First, in order to see whether firms with higher or lower tax rates use more

\(^{10}\)This does not mean all types of assets can either be purchased or leased. A certain type, especially long-lived type, of assets would hardly be leased through operating lease. However, it is reasonable to assume that over a good portion of assets, a firm can choose financing method, such as computers or vehicles, and the focus of this paper is on those types of assets.
lease (all things being equal),

\[
\frac{\partial B}{\partial \tau} = -z + \frac{1 - b_R - \lambda \times (ITC + z\tau_R)}{1 - \tau_R},
\]

(20)

which is negative with a set of reasonable values for other parameters.\textsuperscript{11} The intuitive reason that firms with lower marginal tax rates would use more of operating lease is they can benefit more from indirectly receiving tax shields from high-taxed lessors than directly purchasing.

Second, when tax benefits increase due to a tax reform, firms become to use more off-balance-sheet investment, if \(\lambda\) is sufficiently large (i.e. if lessor passes sufficiently large portion of tax benefits.)

\[
\frac{\partial B}{\partial z} = -\tau + \frac{\lambda}{1 - \tau_R} \tau_R,
\]

(21)

and

\[
\frac{\partial B}{\partial (ITC)} = -1 + \lambda \frac{1 - \tau}{1 - \tau_R}.
\]

(22)

Certainly, if lessors keeps all the benefits (i.e. \(\lambda = 0\)), both equations are strictly negative, thus an increase in \(ITC\) or \(z\) will encourage firms to invest financed through direct purchase (with or without debt). As \(\lambda\) becomes bigger, however, the directions depend on whether the lessee has a higher or lower marginal tax rate than lessors do. Intuitively, a higher-taxed firm can get a larger amount of depreciation allowances associated for a given capital good. Thus, higher taxed lessees would be better off receiving tax benefits directly from government, rather than indirectly from lower-taxed lessors. Even if \(\lambda = 1\) so that lessors passes on tax benefits entirely to lessees, lessees with a full tax rate would not want to switch to leasing. Firms with lower tax rates, therefore, have bigger incentive to switch to leasing when \(ITC\) or \(z\) becomes higher\textsuperscript{12} This can be seen from

\[
\frac{\partial^2 B}{\partial z \partial \tau} = -1 - \frac{\lambda \tau_R}{1 - \tau_R}, (< 0)
\]

(23)

\textsuperscript{11}For example, \(z = 0.8\), \(b_R = 0.5\), and \(\tau_R\) between 0.3 and 0.4.

\textsuperscript{12}One necessary condition for this statement is that lessors do not discriminate lessees based on marginal tax rates so that \(\lambda\) is constant across \(\tau\). I am assuming here that the price elasticity for \(\alpha\) does not vary across different \(\tau\).
and
\[
\frac{\partial^2 B}{\partial (ITC) \partial \tau} = -\frac{\lambda}{1 - \tau_R} (< 0) \tag{24}
\]

Turning to incidence question, equation (21) provides an opportunity to indirectly measure a lower (or upper) bound of \( \lambda \). First note that bonus depreciation policy makes a setting in determining the sign of this equation. Even though different individual firms have different incentives (and thus different signs for this equation), we can still make inference about \( \lambda \) for an average lessor and an average lessee. That is, in a reduced form estimation, if the relative use of off-balance-sheet investment, \( \alpha \), is significantly responsive to changes in \( z \) due to bonus depreciation policy, it can be inferred that, on average, equation (21) is positive. Consequently a lower bound for \( \lambda \) is calculated by rearranging equation (21),
\[
\lambda \geq \frac{\tau (1 - \tau_R)}{\tau_R (1 - \tau)} = \frac{1}{\tau_R} - 1. \tag{25}
\]

Put it differently, \( \lambda \) has to be higher enough to make firms respond to tax policy by changing financing methods. Assuming an average lessor’s marginal tax rate is higher than an average lessee’s marginal tax rate, this lower bound for \( \lambda \) is less than one. The larger the difference between \( \tau \) and \( \tau_R \) is, the lower is \( \lambda \)’s lower bound. Intuitively, when the difference between \( \tau \) and \( \tau_R \) becomes larger, lessees have more strong incentive to turning to operating lease on the margin, so the lessors would not have to give up a larger fraction of tax benefits. If the prediction of equation (21) does not appear significant empirically, on the other hand, the right hand side of equation (25) can be seen as an upper bound of \( \lambda \).

Finally, one may wonder if debt level \( b \) can affect the relative use of off-balance-sheet investment. Since \( \sigma \) is an implicit cost of operating lease usage, it (and \( f \)) contains firm specific elements, and I assume that these firm specific elements are related to each firm’s financial status. For example, depending on financial conditions, some financial-constrained firms are forced to use more off-balance-sheet investments, if they are already employing excess level of debt. On the other hand, firms which are more concerned about net operating loss are more likely discouraged to use operating lease, as this would add more expenses on the income statements. Thus, even
though this equation predicts lower use of off-balance-sheet for a firm with a higher debt level due to a larger deductibility of interest payments (i.e. $\frac{\partial B}{\partial b} = -1$), $f$ is also affected by debt level, so this prediction may not be tested using this model, an issue that is beyond the scope of this paper at this stage.

4 Data Description and Variable Construction

The data consist of all Mining, Utilities, Construction, Manufacturing, Trade, Transportation and Information firms in Compustat from year 1982 to year 2007. Focusing on manufacturing-related industries and excluding financial services firms, there would be little, if any, lessors in the sample. In total, there are 284,590 firm-year data points for all industries during this period. By focusing on firms in the manufacturing-related industries, only keeping firms that existed around temporary bonus depreciation period,\textsuperscript{13} and dropping out observations with missing entries or observations in their first and last years, the sample size of firm-year data reduces to 13,886 with 822 firms. As the Compustat accounting data do not simply tell us how much of capital goods are purchased, or newly leased, especially through operating lease, I explain how I construct the relevant variables in this section.

4.1 Off-balance-sheet Investment: Operating Lease

Operating leases are not treated as ways of obtaining assets in the book, so no direct stock data is available. The variables related to operating leases in Compustat are “Rental Expense (RE)” and “Rental Commitments 5 Years Total (RC5).” $RE$ is the amount of operating lease payment that a firm has to pay in a given year, and $RC5$ is the sum of future operating lease payments (up to 5 years) committed.

\textsuperscript{13}In order to study firms’ behaviors before/during/after bonus depreciation, I only keep firms which appear in Compustat at least three years prior to the introduction of bonus depreciation, and continue to be in the dataset at least three years after the expiration.
To illustrate the measuring procedure, suppose a firm has made three operating-leased investment over the last four years, A, B, and C at $t-4, t-2,$ and $t$, respectively; and one operating-leased investment, $D$, at time $t+1$. $A_0$, $B_0$, $C_0$, and $D_0$ are the initial lease payments of each investment project (i.e. $RE$ at the years when the investments were made), and others will show up at $RC_5$. In this example, it is $(C_0 + C_1)$ that this firm leases for capital goods at time $t$ (in the red box), and thus the one that has to be measured: the firm pays at that time $C_0$, committing itself to paying $C_1$ next year. On its financial statements at time $t$, however, $RE_t$ is $A_4 + B_2 + C_0$, that is, summing up all the lease payments made at time $t$. In order to get $(C_0 + C_1)$, we can use

$$RE_t + ([RC_5]_t - [RC_5]_{t-1}),$$

(26)

as the term $([RC_5]_t - [RC_5]_{t-1})$ controls for the “left-over” lease payments with which investment made previously. For example, at time $t$, $RE$ entry will be $(A_4 + B_2 + C_0)$, and $RC_5$ will be $(A_5 + B_3 + B_4 + B_5 + C_1)$. Similarly, at time $t-1$, $RE$ entry will be $(A_3 + B_1)$, and $RC_5$ will be $(A_4 + A_5 + B_2 + B_3 + B_4 + B_5)$. Thus, $RE_t + ([RC_5]_t - [RC_5]_{t-1}) = C_0 + C_1$, as is needed.\(^{14}\)

In a companion paper, I report that the average duration of true lease is approximately 3 year.

\(^{14}\)Note that both $RE$ and $RC_5$ include the amount of lease payments of structure as well as equipment. One concern is bonus depreciation is specifically designed for equipment investment, so estimates for the effect of bonus depreciation may be biased upward. I assume, therefore, that the amount of structure leasing is stable especially around the time when equipment investment is subsidized to avoid this problem. However, this procedure may well overmeasure off-balance-sheet equipment investment.
commitments need to be discounted. Using 10% of discount rate, I propose.\textsuperscript{15}

\begin{equation}
I_t^{OFF} = 0.9 \ast (RE_t + ([RC5]_t - [RC5]_{t-1})),
\end{equation}

4.2 Balance-Sheet Investment

Following the literature, the main Compustat variable for balance-sheet investment is “Net PPE” \((nPPE)\). Instead of using a simple one-year difference of “Net PPE” \((nPPE)\) measure, \(\Delta nPPE\), I adjust the previous \(nPPE\) (i.e. \(nPPE_{t-1}\)) by book depreciation rates, \(\delta_B\). To see why this adjustment is needed, suppose a firm does not purchase capital goods this year, so I want to have zero as balance-sheet investment measure. If the measure is not adjusted by depreciation rate, \(\Delta nPPE\) would be negative due to this (book) depreciation, instead of zero. Thus I propose\textsuperscript{16}

\begin{equation}
I_t^{BS} = nPPE_t - \delta_B \ast nPPE_{t-1}.
\end{equation}

4.3 The Relative Usage Measure

Naturally, measure for the relative use of off-balance-sheet investment is therefore given by

\begin{equation}
\alpha_t = \frac{I_t^{OFF}}{I_t^{OFF} + I_t^{BS}}.
\end{equation}

One concern is that, even though \(I_t^{OFF}\) and \(I_t^{BS}\) are expected to be non-negative so that \(\alpha\) is between zero and one, these investment measures could be negative due to measurement error or “unexpected” behaviors of lessees (for example, break of the lease contract). This issue of signs is especially problematic in measuring a ratio. For example, suppose a firm is measured to have made off-balance-sheet investment of \(-200\$\) (a negative investment) for any reason, and balance-sheet investment of \(100\$. In this case, the relative use of off-balance-sheet, \(\alpha\) has to be extremely low, but equation (29) measures \(\alpha\) as 2, or 200%. To avoid this problem, I set negative values for

\textsuperscript{15}I assume that, annual lease payments of an operating lease are constant over the leasing duration. Then \(I_t^{OFF} = C + \frac{C}{\Gamma} + \frac{C}{\Gamma^2} \approx 0.9 \ast (3C)\).

\textsuperscript{16}I use 10%, 15% and 20% for depreciation rates to check if the results are sensitive to the choice of \(\delta_B\). The signs and the significances did not change, and the main result is presented with \(\delta_B = 15\%\).
any of off-balance-sheet and balance-sheet investment as zero. This way, around 3% (4%) of all \( I^{OFF} \)s \( I^{BS} \)s, respectively) are affected, but since the absolute values of these negative measures are very small, this procedure does not generate much changes in average values of either variable (i.e. less than 1% change).

### 4.4 Tax Terms

For firms' marginal tax rates, I use Graham's simulated marginal tax rates as \( \tau \) measures.\(^{17}\) Graham performed 50 simulation for each firm in each year by forecasting firm's taxable income eighteen years into the future. This way, the marginal tax rate accounts for net operating carrybacks, carry forwards and alternative minimum tax. For example, a firm that has a net loss this year might be able to fully benefit from bonus depreciation schedule, if the firm can carry the whole loss back. If the firm has to carry it forward, the present value of the benefit would be reduced, but far from zero, which would have been predicted if a marginal tax rate had been calculated based on this year's financial statement. He provided two kinds of simulated marginal tax rates: before-financing marginal tax rates and after-financing marginal tax rates. The difference between the two is whether the tax rate is calculated base on earning before or after interest is deducted. To avoid a possible endogeneity issue between debt level (i.e. a higher debt level indicates a lower after-financing marginal tax rate) and use of off-balance-sheet investment, before-financing marginal tax rates are used in this paper.

Also important tax parameters are investment tax credit (\( ITC \)) and depreciation allowances \( (z) \). Investment tax credit has been created, suspended, and reactivated multiple times since 1960's, and Cummins, Hassett, and Hubbard (1994) contains a thorough description on this. They also provide an averaged measure of the credit over manufacturing equipment and structure, which is needed for this paper as I do not have asset-level information with accounting data. During the periods of this paper's focus, which are after The Economic Recovery Tax Act of 1981 (ERTA 1981) was enacted, the average investment tax credit structure was quite simple: 0.0789 up to year 1986, and zero (0) from year 1987 on. There are three major changes in

\(^{17}\)Graham has generously provided this data.
depreciation allowances: ERTA 1981, Tax Reform Act of 1986 (TRA86) and Bonus Depreciation in 2002. ERTA 1981 initially provided a generous depreciation allowance structure, but due to budget deficit concerns, the generosity faded away one year later. The purpose of TRA86 was to make accounting depreciation close to economic depreciation, creating Modified Accelerated Cost Recovery System (MACRS) structure that is still in effect. In 2002, President Bush signed into law the Jobs Creation and Worker Assistance Act of 2002 that temporarily provided accelerated depreciation allowance, also known as "Bonus Depreciation." Under Bonus Depreciation, a firm that invested in qualified equipment could write off 30% of the investment (or 50% depending on the timing of the investment decision) immediately in the first year, and then followed the regular depreciation schedule for the remaining amount. In this paper, I am using, for $z$, the present values of depreciation allowance calculated and presented in Table 2.21 in Jorgenson and Yun (1991) until 1986, after which $z$ measures are taken from Knittel (2007) and House and Shapiro (2008).

5 Results and Implications

5.1 Data Summary

In table below is the summary of data of the 13,886 firm-year observations. The mean and the median of $\alpha$ in raw data are 0.31892 and 0.24590, respectively, which is roughly consistent with other sources such as 1994 U.S. Industrial Outlook. As explained above, a negative measure of either $I^\text{OFF}$ and $I^\text{BS}$ can make significant errors in measuring a ratio, I set those as zero. In total, 506 of $I^\text{OFF}$ entries and 562 of $I^\text{BS}$ entries are affected by this procedure, but these consist of less than 4% of whole observation, and this procedure does not change mean or median $I$ measures significantly.

$^{18}$For the measure of capital stock $K$, PPE is used for this table. As the variable of interests is $\alpha$, the relative use of off-balance-sheet investment, $K$ measure is not used for analysis.
<table>
<thead>
<tr>
<th></th>
<th>Mean (raw)</th>
<th>Med. (raw)</th>
<th># of Negatives</th>
<th>Mean (adjusted)</th>
<th>Med. (adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I^{OFF}/K$</td>
<td>0.28239</td>
<td>0.07011</td>
<td>506 (3.6%)</td>
<td>0.28477</td>
<td>0.07011</td>
</tr>
<tr>
<td>$I^{BS}/K$</td>
<td>0.35198</td>
<td>0.21330</td>
<td>562 (4.0%)</td>
<td>0.35563</td>
<td>0.21330</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.31892</td>
<td>0.24590</td>
<td></td>
<td>0.33614</td>
<td>0.24893</td>
</tr>
</tbody>
</table>

5.2 Empirical Model

In this section, I test whether firms’ off-balance-sheet investment behavior follows the predictions made in the earlier section. That is, (1) whether firms have increased the use of off-balance-sheet investment after the introduction of bonus depreciation (i.e. $z$ increased); (2) whether the effects of (1) are larger for firms with lower marginal tax rates; (3) whether firms have increased or decreased the use of off-balance-sheet investment after TRA86 reform (i.e. $ITC$ removed, $z$ decreased; but $\tau$ and $\tau_R$ decreased); and (4) whether firms with lower marginal tax rates, in general, have a higher use of off-balance-sheet investment. I therefore consider estimating the following equation

$$\alpha_{it} = \beta_0 + \beta_1 D_{BS7} + \beta_2 D_{BS7} \ast \tau_{it} + \beta_3 D_{BND} + \beta_4 D_{BND} \ast \tau_{it} + \beta_5 D_{else} \ast \tau_{it} + \beta_6 c_t + f_i + \epsilon_{it}, \quad (30)$$

where subscript $i$ and $t$ indicate firm and year, respectively. $\alpha_{it}$ is firm $i$’s relative use of off-balance-sheet investment, $D_{BS7}$ dummy for being before year 1987, $D_{BND}$ dummy for being between year 2002 and year 2004, $D_{else}$ dummy for being otherwise, $f_i$ firm’s fixed effect, and $c_t$ time trend. In the regression, as explained before, the base measure for $\tau_{it}$ is Graham’s before-financing marginal tax rate. However, the prediction about the relationship between lessee’s marginal tax rates and leasing is made by holding constant other things including lessor’s marginal tax rates. Therefore, using lessee’s relative marginal tax rate at a given time is more consistent with this prediction. For this reason, I use a “de-meaned” tax rate, $\tau_{i,t} = \tau_{it} - \bar{\tau}_t$, that is, firm $i$’s marginal tax rate at year $t$, net of the average marginal tax rate of all the firms at time $t$. This de-meaned marginal tax rate is consistent with this model in the sense that the effect of marginal tax rate on relative
use of leasing can be seen as difference (from that of lessor’s). For comparison, I also report results with logarithm of α for the dependent variable.

5.3 Result

Reported in Table 1 are the results of fixed effect panel regressions. The impact of bonus depreciation is identified through $D_{BND}$, dummy for being between year 2002 and year 2004, especially with de-meaned tax rates controlling for a aggregate shock in the marginal tax rates in the particular period.

[Insert Table 1 here]

During the bonus period, the fraction of off-balance-sheet investment ($\alpha$) was 2.5 to 3.5 percentage point higher than other years. As the coefficients for $D_{BND}$ are significantly positive for all the specifications, it can be inferred that lessors have passed on at least some of tax benefits to lessees on average, and that lessees have turn to switching to leasing during bonus depreciation period. From equation (24), therefore, a lower bound can be estimated, as discussed earlier.

$$\lambda = \frac{\tau_R - \frac{1}{\tau} - 1}{\frac{1}{\tau} - 1}. \quad (31)$$

The average value of before-financing marginal tax rates in 2001 was 0.28, the third quartile of the tax rate was approximately 0.35, and the maximum rate was 0.39. Assuming lessee’s marginal tax rates are at least higher than the average tax rate in a given year and evenly distributed over the upper half (i.e. between the average rate and the full rate), an average lessee’s marginal tax rate, $\tau$, is 0.28 and an average lessor’s marginal tax rate, $\tau_R$, is 0.34 ($= (0.28 + 0.39) / 2$), so that the lower bound is calculated as 75%. If we assume that all lessors are fully taxable (i.e.

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19 This does not mean that lessor’s marginal tax rates would be typically higher than the average $\tau$ at a given year. The key point of this procedure is to capture the relative “location” of a lessee’s marginal tax rate among all the lessees.

20 Bonus depreciation is specifically designed for new assets installed during the “right” period. The variables constructed in this paper cannot distinguish new assets from used assets. However, the key variable is the relative usage of off-balance-sheet investment, $\alpha$, and all that has to be assumed is that from period to period, the relative usage of new assets is independent of the relative usage of leasing. Also Edgerton (2009) reports that the relative price of used assets compared to new assets did not change significantly during bonus depreciation period, suggesting that there is no evidence of shifting from used assets to new assets during this period.
lessors’ marginal tax rate is the highest one for the given year) so that $\tau_R$ is 0.39 in 2001, the lower bound is calculated as 60%, on average.\textsuperscript{21}

Having confirmed that lessors share some of tax benefits with lessees, and therefore lessee’s responded to bonus depreciation policy by switching to leasing, I turn to detailed lessee’s behaviors based on lessee’s marginal tax rates. First, firms with lower tax rates uses more off-balance-sheet investment across the periods (from the coefficients for $D_{BS7}*\tau$, $D_{BND}*\tau$, and $D_{else}*\tau$). However, the coefficient for the temporary bonus depreciation does not appear to be particularly higher than those for other periods, which is against one of predictions that lessees with lower tax rates have more incentive to switching to leasing with increased $z$, if $\lambda$ is constant across $\tau$. This result implies that, $\lambda$ may not be constant for different $\tau$’s: that is, lessors may have discriminated lessees based on lessees’ marginal tax rates, by passing on less portion of tax benefits to firms with lower tax rates, because firms with lower tax rates have more to gain from leasing, and so would demand less benefit from lessors.\textsuperscript{22} To see this more in detail, I group lessee firms into three categories depending on the firms’ average marginal tax rates in year 2000 and year 2001 (right before the introduction of bonus depreciation): firms with lower tax rates, middle tax rates, and higher tax rates.

| <Three Groups Based On Marginal Tax Rate in 2001> |
|---------|---------|---------|
| marginal tax rate | Group 1 | Group 2 | Group 3 |
| $0 \leq \tau_{it} < 0.3$ | 295 | 371 | 339 |
| $0.3 \leq \tau_{it} < 0.35$ | | | |
| $0.35 \leq \tau_{it} < 0.39$ | | | |

The equation (30) is estimated for each group. For this regression, I use $\log(\alpha_{it})$ for dependent variable, so that I can compare the coefficient of $D_{BND}$ for different groups. The results are reported in Table 2.

\textsuperscript{21}By “on average,” I mean this lower bound is averaged over lower bounds of $\lambda$s of sub-markets which lessors may have discriminated lessees based on.

\textsuperscript{22}While this discrimination makes an intuitive sense, it would be more natural to think that lessors would discriminate lessees based on lessees’ credit risks which in turn would be related to lessees’ marginal tax rates. This relationship between credit risk and marginal tax rate is to be studied.
It turns out that the responsiveness of financing methods to bonus depreciation policy varies significantly across the groups. First, firms with lowest tax rates have not responded to bonus depreciation rate. It is may be because firms with low tax rates simply do not bother to switch to leasing (low price elasticity for $\alpha$), or because lessors do not offer them enough incentive. To the extent to which a firm’s marginal tax rate is (inversely) correlated with its credit risk, lessors may be reluctant to pass on as much tax benefits to higher-risk firms (or lower-taxed firms) as to other firms. Second, firms with the highest tax rates do respond to bonus depreciation policy by switching to leasing. This is not surprising if we believe lessors are generally the ones with higher tax rates, such as financial institutions. However, the response from the firms with the middle tax rates is the strongest – among this group, the relative use of off-balance-sheet investment is increased by 17% during bonus period. Certainly they have more incentive to switch to leasing than firms with highest tax rates, and are likely to have lower marginal tax rates than lessors. They are also likely to have better access to credit market than firms with lowest tax rates, so that they can negotiate with lessors better.

Finally, comparing the second column (panel 2 using $\tau_{it}$) and the third column (panel 3 using $\tau_{it}$), the coefficient for $D_{BS7}$ are quite different. Since in panel 3, de-meaned tax rates are used, instead of raw marginal tax rates, the effect of TRA86 lowering corporate tax rates is removed, so that the coefficient of $D_{BS7}$ in panel 3 would capture only the effects of changing $ITC$ or $z$ in TRA86, which turn out insignificant. Not only this insignificance, but also the positive estimate for the coefficient of $D_{BS7}$ in panel 2 are hard to interpret based on the model developed here. My conjecture is TRA86 was such a huge shock that it affected individuals and firms behaviors in many more dimensions (other than these three parameters: $ITC$, $z$, and $\tau$). For example, the introduction of corporate $AMT$ might have given firms additional incentives of leasing, offsetting the repeal of $ITC$ and the reduction in $z$. This topic related to $AMT$ and leasing is interesting, but beyond the scope of this paper.

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23 Also, even though a lessee and a lessor have similar tax rates, the lessee may still have an incentive to switch to leasing when $z$ gets higher, if there is uncertainty in the lessee’s marginal tax rate. In this case, the lessee may be willing to give up $\lambda$ portion of tax benefits to the lessor as uncertainty cost.
6 Conclusion

I study the tax responsiveness of off-balance-sheet leased investment, that is, investment financed through operating lease. Unlike direct purchase, assets that a firm leases through operating lease are not conveniently reported in accounting data, so I propose a way of constructing the off-balance-sheet investment measures. With this data, I find that off-balance-sheet investment responds strongly to its relative tax costs to balance-sheet investment. The model developed in this paper implies that an increase in investment incentives such as depreciation allowances (i.e. introduction of bonus depreciation) makes off-balance-sheet investment more attractive than balance-sheet investment, and I find evidence that relative use of off-balance-sheet investment strongly responds to bonus depreciation policy. I also find evidence that lessees with lower tax rates may have been discriminated in operating lease market, but on average, lessors share tax savings, on average, with lessees.

References


Appendix. Summary of SFAS No. 13

SFAS No. 13 specifies four main criteria for treating a lease as a capital lease by the lessee:

1. Transfer of Ownership: The lease transfers ownership to the lessee at the end of the lease term.

2. Bargain Purchase Option: The lease contains a bargain purchase option, under which the lessee can purchase the leased property at a price significantly below the expected fair value of the leased property at the end of the lease term.

3. 75 percent of Economic Life: The term of the lease (plus any bargain renewal option) is equal to or greater than 75% of the estimated economic life of the leased property.

4. 90 percent of Asset’s Value: The present value of the minimum lease payments to be made by the lessee (excluding executory costs such as insurance, maintenance, and taxes) is equal to or greater than 90% of the fair value of the leased property.
Table 1: Main Empirical Results

<table>
<thead>
<tr>
<th>dependent variable</th>
<th>panel 1</th>
<th>panel 2</th>
<th>panel 3</th>
<th>panel 4</th>
<th>pooled OLS</th>
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<tr>
<td>α</td>
<td>-0.037017</td>
<td>0.093901</td>
<td>-0.009657</td>
<td>-0.041969</td>
<td>0.002309</td>
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<tr>
<td>ln(α)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>τ</td>
<td>-0.394418</td>
<td>-0.411805</td>
<td>-0.406461</td>
<td>-2.192794</td>
<td>-0.569487</td>
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<tr>
<td>τ_t</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>τ_i</td>
<td>0.035201</td>
<td>0.027843</td>
<td>0.025611</td>
<td>0.123558</td>
<td>0.022134</td>
</tr>
<tr>
<td>τ_i,t</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DB87</td>
<td>-0.214518</td>
<td>-0.257110</td>
<td>-0.246488</td>
<td>-0.615122</td>
<td>-0.334300</td>
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<tr>
<td>DB87 * τ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DBND</td>
<td>-0.169143</td>
<td>-0.247781</td>
<td>-0.225748</td>
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<td>-0.344376</td>
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<td>DBND * τ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>De else * τ</td>
<td>-0.00838</td>
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<td>YES</td>
<td>YES</td>
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<tr>
<td>observations</td>
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<td>12723</td>
<td>12425</td>
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<tr>
<td>adjusted $R^2$</td>
<td>0.4861</td>
<td>0.4882</td>
<td>0.4881</td>
<td>0.3178</td>
<td>0.0541</td>
</tr>
</tbody>
</table>

Note: P-values are in parentheses.
Table 2: Empirical Results for Each Group

<table>
<thead>
<tr>
<th>marginal tax rates</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>lower 0 ≤ τ&lt;sub&gt;it&lt;/sub&gt; &lt; 0.3</td>
<td>0.174152 (0.285)</td>
<td>0.006750 (0.955)</td>
<td>-0.039360 (0.594)</td>
</tr>
<tr>
<td>middle 0.3 ≤ τ&lt;sub&gt;it&lt;/sub&gt; &lt; 0.35</td>
<td>-1.246504 (0.288)</td>
<td>-3.904181 (0.000)</td>
<td>-1.063668 (0.134)</td>
</tr>
<tr>
<td>higher 0.35 ≤ τ&lt;sub&gt;it&lt;/sub&gt; &lt; 0.39</td>
<td>0.094505 (0.337)</td>
<td>0.171190 (0.015)</td>
<td>0.108750 (0.015)</td>
</tr>
</tbody>
</table>

Note: P-values are in parentheses. Dependent variables are log(α) instead of α. Tax rates are de-meaned before-financing marginal tax rates, τ<sub>i,t</sub>.