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Leasing and Debt Financing: Substitutes or Complements?

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Abstract

Traditional finance theories typically treat leases and debt as substitutes. However, the empirical findings on the relation between leases and debt are mixed. This paper reinvestigates this relation. I present a model to incorporate different theories on the substitutability and complementarity between leases and debt, and I test the model implications empirically in a GMM framework that simultaneously controls for endogeneity problems and firms' fixed effects. The findings suggest that leases and debt are substitutes instead of complements. I also investigate the variation in the substitutability between leases and debt, and find that in those firms with more growth options or larger marginal tax rates, or in those firms paying no dividends, the substitutability is more pronounced, i.e., the cost of new debt increases to a larger degree with extra leases.

I. Introduction

Both leases and debt are important financing instruments commonly used by corporations. However, the relation between leasing and debt financing has not been well understood. Traditional theories typically treat leases and debt as substitutes, i.e., an increase in the use of lease financing should be associated with a lower level of conventional debt financing. Yet the empirical evidence on this relation is mixed. Ang and Peterson (1983) present a leasing puzzle by showing that leases and debt are complements even after controlling for differences in debt capacity. By contrast, Marston and Harris (1988) and Krishnan and Moyer (1994) provide evidence suggesting that leases and debt are substitutes.[1] One possible explanation for this empirical controversy is that an identification problem may be present in previous studies. As a result, the relation between leases and debt in those studies could be an unidentified mix of both the true relation and the factors that simultaneously affect leasing and debt financing.

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[1] See also Adedeji and Stapleton (1996) and Beattie, Goodacre, and Thomson (2000) for recent evidence on lease-debt substitutability.

In this paper, I reexamine the relation between leases and debt. The paper incorporates different theories on this relation into a simple structural model from which I derive testable hypotheses. I examine a firm that invests in a new project. The firm can choose between leasing and debt financing to finance its investment. In the model, the substitutability and complementarity between leases and debt are interpreted based on the firm's financing cost function. Specifically, leases and debt are substitutes when the cost of debt increases with leases, or when the cost of leases increases with debt. This interpretation is consistent with the trade-off theory of capital structure, which suggests that leases and debt are substitutes since an extra amount of leases increases the possibility of future financial distress and thus the cost of debt. On the other hand, I interpret leases and debt as complements when the cost of debt (leases) decreases with leases (debt). This interpretation is consistent with the tax arbitrage theory introduced by Lewis and Schallheim (1992) who suggest that leases and debt can be complements since a lessee can sell its tax shields to a lessor through leases. Thus, more leases reduce the potential redundancy of tax shields and hence the cost of debt.

I then use a generalized method of moments (GMM) technique developed by Arellano and Bond (1991) and Arellano and Bover (1995) to empirically test the relation between leases and debt. This technique enables me to simultaneously control for endogeneity problems and firms' fixed effects, so that I can isolate the true relation between leases and debt from other factors that may endogenously induce a correlation between leases and debt. Using GMM, I reject the hypothesis that leases and debt are complements, but I cannot reject that they are substitutes. This result is robust to alternative measures of leases, such as the perpetuity method proposed in Lim, Mann, and Mihov (2004), and to the alternative choices of instrumental variables in GMM estimations.

I also examine the variation in the substitutability between leases and debt across different firms. I find that the substitutability is more pronounced (i.e., the cost of debt increases more with leases) in those firms with more investment opportunities or higher marginal tax rates, or in those firms paying dividends less often. These results are consistent with the agency cost hypothesis, the tax hypothesis, and the asymmetric information hypothesis, respectively.

This paper relates to several strands of finance literature. As mentioned earlier, there exists a large finance literature with mixed results on the empirical relation between leases and debt.[2] Smith and Wakeman (1985) point out that this ambiguity may reflect the difficulty of empirically controlling for debt capacity. To avoid this identification problem, Bayless and Diltz (1988) utilize an experimental setting in which banks were queried regarding the amount of funds they would be willing to lend under various hypothetical circumstances. They find that banks do not treat outstanding capitalized leases and debt differently. Several recent papers bypass the direct estimation of this relation by assuming the substitutability between leases and debt, and explore the role of leasing in firms' financing policies. For example, Sharpe and Nguyen (1995) hypothesize that firms can reduce the cost of external funds arising from asymmetric information

[2]There also exists a large theoretical literature on tax-related incentives to lease or buy (see, e.g., Miller and Upton (1976), or Lewellen, Long, and McConnell (1976)), and on valuation of leasing contracts (see, e.g., McConnell and Schallheim (1983)).

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problems through leasing, and they find that firms facing high financial contracting costs have a greater propensity to lease.[3] Further, Barclay and Smith (1995) focus on the maturity and priority structure of corporate external obligations and examine three prevailing explanations for corporate financing choices including leasing and debt financing. They provide evidence for the incentive-contracting explanation, but not for the signaling and the tax explanations.

The paper is organized as follows. Section II introduces the model and derives testable hypotheses. Section III describes the econometric model and presents empirical results. Section IV concludes.

II. The Model

In this section, I construct a model to conceptualize the relation between leasing and debt financing. This model is stripped down to its essentials. It is meant to capture, in a reduced form, the effects of asymmetric information, moral hazard, and taxes on the cost of external funds. I use the model to incorporate various explanations on the relation between leases and debt, and to derive testable hypotheses under which leases and debt are substitutes or complements. In this paper, I do not distinguish among different types of debt or leases in terms of priority, maturity, and seniority.[4] Instead, I consider a homogeneous class of debt and a homogeneous class of leases, since my focus is on the relation between debt and leases, not that among different types of debt or different types of leases.

I examine a risk-neutral firm (entrepreneur) that is planning to invest in a new project. For simplicity, I assume that the firm has no other existing projects. The firm has available to it an amount of internal capital, W, which is insufficient to fund the new project to the first-best level. Thus, the firm needs to finance externally. I assume that the firm can raise extra funds either through lease financing or debt financing.[5] In debt financing, the firm borrows from banks or other similar financial institutions, while in the case of leasing the firm obtains financing from manufacturers or leasing companies.[6] The firm chooses between

[3]Krishnan and Moyer (1994), Barclay and Smith (1995), and Graham, Lemmon, and Schallheim (1998) also report similar results that support this financial contracting cost hypothesis.

[4]A lease is classified as either an operating lease or a capitalized lease in a financial accounting context, while, from a legal or tax perspective, a lease contract is either a true lease or a non-true lease (also called "conditional-sales contract" by the IRS). In this paper, I do not distinguish between the classification in the accounting context and the classification in the tax context, since the inconsistency between the tax and accounting classifications is limited even though the two classifications do not match exactly. Instead, I will treat non-tax leases as capitalized leases and tax leases as operating leases.

[5]I do not consider the possibility of issuing equity to finance the investment.

[6]I assume that debt and leases can be used interchangeably to finance a new project. However, I recognize that in practice, it may not be the case. A firm can use leases only to finance a purchase of an asset, while it can use debt not only to purchase assets, but also to finance working capital or change capital structure (e.g., in exchange offers). In this paper, I choose to abstract away from this difference between leases and debt in order to simplify exposition of the paper. However, even if this difference is considered, the empirical implications in the paper would remain unchanged. Incorporating this difference would affect the model in two ways. First, since leases are always associated with a tangible asset, the increased likelihood of bankruptcy arising from leasing would be smaller compared to the case where debt is used. However, this feature of leasing would have the same effect on the model as the high priority of leases, in that both features imply a lower financial distress cost for leasing compared to debt financing. I consider explicitly the different priorities between debt and

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these two financing alternatives in order to maximize the net present value of its investment in the new project (and thus the firm's value). Therefore, the firm faces the following problem,

$$\begin{aligned} (1) \qquad & \underset{d,l,i}{\text{Max}}\, M(i) - C(D+d, L+l\,;x) \\ & \text{s.t.} \qquad W + d + l \;=\; i, \end{aligned}$$

where i stands for the amount of investment in the project, d is the amount of new debt raised to fund the new investment, l is the amount of new leases raised, D is the amount of existing debt, L is the amount of existing leases, x is a vector including other factors affecting the firm's external financing cost, $M(\cdot)$ is the payoff function of the investment, and $C(\cdot)$ is the financing cost function.

In this paper, I do not explore the structural form of the financing cost function. Instead, I assume that the cost function C includes all the possible cash flows associated with financing activities. Thus, it can be viewed as comprising two parts: first, the explicit cost of financing, e.g., face value of debt and lease payments, and second, the implicit costs and benefits associated with debt and lease financing, e.g., financial distress costs and tax benefits.

I assume that the firm's payoff from its new investment follows a pattern of decreasing returns to scale, i.e., $M' > 0$ and $M'' < 0$. I also assume that the firm's financing cost function has positive first and second derivatives with respect to leases and debt, i.e., $C_1 = \partial C/\partial(D+d) > 0$, $C_2 = \partial C/\partial(L+l) > 0$, $C_{11} > 0$, and $C_{22} > 0$. Here C_1 (C_2) represents the marginal cost of debt financing and the marginal cost of leasing, respectively. C_{11} (C_{22}) represents the change in the cost of debt financing (leasing) in response to an extra amount of debt (leases). The assumptions on C_{11} and C_{22} imply the existence of market imperfections. In a Modigliani-Miller world, the cost function $C(D+d, L+l\,;x)$ would be a linear function $\rho(D+d+L+l)$, where ρ is the firm's constant required rate of return (ρ can also be interpreted as the weighted average of the rate of return of leases and the rate of return of debt in my framework). In such a world, the external financing choice between leases and debt would be irrelevant to the investment decision and to the firm's value. However, in a world with market imperfections such as asymmetric information and moral hazard, the firm's external financing cost function becomes a nonlinear function. The Appendix provides a numerical example for the effect of information asymmetry, one possible market imperfection, on the firm's financing cost function.

The first-order conditions for model (1) are

$$\begin{aligned} (2) \qquad & M' - C_1 \;=\; 0, \qquad \text{and} \\ & M' - C_2 \;=\; 0. \end{aligned}$$

I denote the solutions to these two equations as $l(D, L\,;x)$ and $d(D, L\,;x)$.

leases. Second, the overinvestment problem (Jensen (1986)) or asset substitution problem (Jensen and Meckling (1976)) could be mitigated with lease financing compared to debt financing. As I discuss later in the paper, this consideration does not affect my testable hypothesis qualitatively.

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Taking the derivatives of equations (2) with respect to L and solving for $\partial d/\partial L$ yields

$$\frac{\partial d}{\partial L} = \frac{M''(C_{12} - C_{22})}{H}. \tag{3}$$

Similarly, taking the derivatives of equations (2) with respect to D and solving for $\partial l/\partial D$ yields

$$\frac{\partial l}{\partial D} = \frac{M''(C_{21} - C_{11})}{H}. \tag{4}$$

Here C_{12} is the change in the cost of debt financing in response to an extra amount of existing leases, C_{21} is the change in the cost of leasing in response to an extra amount of existing debt ($C_{12} = C_{21}$ for any given amounts of debt and leases), and $H = (M'' - C_{11})(M'' - C_{22}) - (M'' - C_{12})^2$ is the determinant of the Hessian matrix. I assume that there is an interior solution for this maximization problem, i.e., $H > 0$. Like C_{11} and C_{22}, both C_{12} and C_{21} are affected by market imperfections as well. The numerical example in the Appendix shows how information asymmetry, one possible market imperfection, affects C_{12}, one of the two cross-derivatives.

A. Substitutability/Complementarity between Leases and Debt

Microeconomic theories generally interpret the substitutability/complementarity of two inputs by the production function of these two inputs. If one treats leases and debt as two inputs and the total amount of external funds raised, $i(d, l)$, as the output of financing process, then according to microeconomic theories, leases and debt are substitutes when the second cross-derivative of $i(d, l)$ is positive and complements when it is negative. However, this prediction is not consistent with the finance literature, which relies on the financing costs of leases and debt rather than their productivity to interpret their substitutability/complementarity.

The finance literature offers two different theories on the relation between debt and leases. First, according to the trade-off theory of capital structure, leases and debt are substitutes. The trade-off theory suggests that each firm has its own optimal leverage ratio, which is determined by the trade-off between the benefits and the costs of fixed claim obligations. The benefits of fixed claim obligations come primarily from the tax deductibility of fixed payments. The primary costs are those related to financial distress, personal income taxes, and agency problems. According to this theory, any additional fixed claim obligation such as debt or leases would increase the possibility of financial distress or the possibility of underinvestment (Myers (1977)), which would in turn lead to a larger cost of further external financing. In other words, the trade-off theory predicts that leases and debt are substitutes since a firm's marginal cost of new debt or new leases increases with fixed claim obligations in place, i.e., $C_{12} > 0$ and $C_{21} > 0$.

However, the trade-off theory does not consider the opportunity of tax arbitrage in lease transactions. Lewis and Schallheim (1992) examine this opportunity in detail. They argue that leases and debt can be complements because the lessee in a lease contract can sell excess tax shields to the lessor. If the lessee uses more

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leases (and thereby sells more of its non-debt tax shields), the potential redundancy of its tax shields will be reduced. Consequently, the lessee's tax benefits from issuing debt will be increased, which leads to a reduced marginal cost of debt for the lessee. Thus, the tax arbitrage theory suggests that the marginal cost of debt decreases in the use of leases, i.e., $C_{12} < 0$. Similarly, the tax arbitrage theory also suggests that the marginal cost of leases decreases in the amount of existing debt, i.e., $C_{21} < 0$. If a firm (a lessee) issues more debt, its effective marginal tax rate can be reduced, so that the firm is more likely to locate a lessor with a higher effective marginal tax rate. Since such a lessor places a great value on tax shields, it is willing to demand smaller lease payments from the firm, which reduce the firm's cost of leasing.

By incorporating these two theories into the model, I develop the implications as presented in Table 1. According to Table 1, $\partial d/\partial L$ and $\partial l/\partial D$ are positive if leases and debt are complements, but ambiguous if they are substitutes. The intuition is as follows. The first-order conditions indicate that the firm chooses the amounts of debt and leases such that the marginal cost of debt is equal to that of leases. If leases and debt are complements, then an extra amount of leases increases the cost of leases and reduces the cost of debt. In this case, to minimize the total financing cost, it is optimal for the firm to cut back on its lease financing and replace it with debt financing, i.e., $\partial d/\partial L > 0$. Using a similar rationale, it can also be shown that $\partial l/\partial D > 0$ if leases and debt are complements.

TABLE 1
Model Implications

	Substitutes (C_{12}, $C_{21} > 0$)	Complements (C_{12}, $C_{21} < 0$)
$\text{Sign}\left(\frac{\partial d}{\partial L}\right)$	+ or −	+
$\text{Sign}\left(\frac{\partial l}{\partial D}\right)$	+ or −	+

On the other hand, if leases and debt are substitutes, an extra amount of leases raises the cost of both leases and debt. In this case, whether a firm should rely more on debt or on leases for its external financing is ambiguous, since it depends on the comparison between the increment in the cost of debt and that in the cost of leases. If extra leases cause the cost of debt to rise more than the cost of leases (i.e., $C_{12} > C_{22}$), then it is optimal for the firm to issue less new debt, in which case $\partial d/\partial L < 0$. Otherwise, if the cost of debt rises less than the cost of leases (i.e., $C_{12} < C_{22}$), then it is optimal for the firm to issue more new debt, in which case $\partial d/\partial L > 0$. Similarly, the sign of $\partial l/\partial D$ is ambiguous if leases and debt are substitutes.

Therefore, by estimating $\partial d/\partial L$ and $\partial l/\partial D$, I can test the hypothesis that leases and debt are complements. If both $\partial d/\partial L$ and $\partial l/\partial D$ are positive, I cannot reject the hypothesis that leases and debt are complements. However, if either $\partial d/\partial L$ or $\partial l/\partial D$ is negative, I can reject the hypothesis that leases and debt are complements, but cannot reject the hypothesis that they are substitutes.

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B. Sensitivity of Substitutability

In this section, I discuss the variation in the substitutability between debt and leases across different firms, i.e., the cross-sectional difference of the effect of leases on the cost of debt.

1. Asymmetric Information

Myers and Majluf (1984) suggest that external funds may be undervalued if a firm faces information asymmetry problems. However, although the influence of information asymmetry on the marginal financing cost (i.e., the first derivative of financing cost function) is well documented, few papers study how the change of marginal financing cost (i.e., the second derivative of financing cost function) relates to information asymmetry. Here I argue that for a firm that faces more severe asymmetric information problems, its marginal cost of external funds will be affected to a larger degree by an extra amount of fixed claim obligations. The intuition is as follows. Consider a firm that plans to finance its investment externally from the capital market. The firm knows privately that its investment can generate high cash flows with certainty, but the market does not have this information. If the market believes that the firm is more likely to earn low cash flows (so that the firm faces a greater degree of information asymmetry), the market will be more concerned about the firm's increased risk of financial distress associated with extra fixed claim obligations. As a result, the risk premium demanded by the market will increase more rapidly when the firm borrows more new funds. Put differently, the above discussion implies that $\partial C_{ij}/\partial\alpha > 0$, where $i, j = 1, 2$, and α captures the degree of information asymmetry in the market. Thus, my hypothesis is that the substitutability between debt and leases is more pronounced in firms that suffer more from information asymmetry.

I now discuss how to test this asymmetric information hypothesis. It is known that lessors are more protected in the case of bankruptcies and face less downside risk than do debtholders because of the high priority of leases. Consequently, the market value of leases is less sensitive to information asymmetry, which implies that the cost of leasing is influenced less by information asymmetry, compared to the cost of borrowing (i.e., $\partial C_{12}/\partial\alpha > \partial C_{22}/\partial\alpha$). Therefore, when a firm faces more severe asymmetric information problems, C_{12} is more likely to exceed C_{22}, and according to equation (3), $\partial d/\partial L$ is more likely to be negative.[7] Following this rationale, I will test the asymmetric information hypothesis based on the change in the sign in $\partial d/\partial L$.[8] I expect that the sign of $\partial d/\partial L$ changes from positive or insignificant to negative with a sufficient increase in the degree of information asymmetry.

[7] The denominator of $\partial d/\partial L$, i.e., H, is also a function of the degree of asymmetric information, α. However, a change in H will only affect the magnitude of the change of new debt with respect to leases in place, but not the direction (i.e., the sign). Since the empirical tests focus only on the change in the sign in $\partial d/\partial L$, the effects arising from $\partial H/\partial\alpha$ can be ignored.

[8] I focus only on the change in the sign in $\partial d/\partial L$ rather than on the change in $\partial d/\partial L$ itself, since the prediction is ambiguous on how $\partial d/\partial L$ changes with information asymmetry. This ambiguity arises because $\partial d/\partial L$ is not only determined by $C_{12} - C_{22}$, but also by the denominator, H. Although $C_{12} - C_{22}$ increases with a larger degree of information asymmetry, the effect of information asymmetry on H is ambiguous. Thus, the change in $\partial d/\partial L$ might be nonlinear with an increase in the degree of information asymmetry.

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2. Agency Costs

Myers (1977) suggests that deteriorated liabilities could force managers to pass up positive NPV projects. Compare a growth firm with many investment opportunities to a mature firm with few investment opportunities. Clearly, the likelihood and the cost of underinvestment in the growth firm are greater than those in the mature firm. Therefore, the cost of new debt or new leases in the growth firm would be positively affected by existing liabilities to a greater degree than would that in the mature firm.

The above conclusion can also be reached if one considers the agency problem proposed by Jensen (1986) who suggests that managers with too much free cash flow in hand tend to overinvest. Financing with debt or leases can reduce a firm's free cash flow, thereby mitigating the overinvestment problem and reducing the firm's agency costs.[9] Again, I compare a growth firm with a mature firm. Clearly, the growth firm has less free cash flow and is less likely to overinvest. Therefore, the reduction in agency costs achieved by new debt or leases, whether in the first order (i.e., the first derivative of the cost function) or in the second order (i.e., the second derivative of the cost function), would be greater in the mature firm than in the growth firm.

Considering the above two theories on agency costs, I hypothesize that the substitutability between leases and debt is more pronounced in firms with more growth opportunities. Following the same rationale that I develop to test the asymmetric information hypothesis, I argue that the cost of leasing is influenced less by agency problems than is the cost of borrowing. Therefore, a change of sign ($\partial d/\partial L$) is expected from positive to negative with more investment opportunities.[10]

3. Taxes

The trade-off theory of capital structure suggests that the use of leases could lead to redundant tax shields, which implicitly increase a firm's cost of new debt. Further, when a firm has a higher marginal tax rate so that the redundancy of tax shields is more costly to the firm, its cost of new debt will increase to a greater degree in response to the use of leases, compared to a firm with a low marginal tax rate, i.e., C_{12} is larger in such a firm. Thus, I hypothesize that the substitutability between leases and debt is more pronounced in firms with higher effective marginal tax rates, and I expect that $\partial d/\partial L$ is more likely to be negative in those firms.

[9]Leases may be more effective than debt in mitigating the overinvestment problem, since leases are always associated with purchases of assets but a firm can use funds raised from debt for many other purposes, e.g., "empire building." Nevertheless, although at different magnitudes, both debt and leases can help prevent managers' opportunistic behaviors.

[10]The overinvestment problem is less severe in the case of lease financing compared to the case of debt financing since leases are always associated with purchases of assets while debt is not necessarily so. On the other hand, leasing has its own unique agency problem, namely, the incentive for asset abuse. The increase in the asset abuse problem could possibly offset the reduction in the overinvestment problem. Thus, a change in sign ($\partial d/\partial L$) from positive to negative could also indicate that in the case of leasing the importance of the agency cost arising from overinvestment dominates the importance of the agency cost arising from asset abuse. I thank the referee for this insight.

III. Empirical Evidence

A. Econometric Model

I use a linear model in my regressions,

$$
\begin{aligned}
(5) \qquad d_{i,t} &= a_i^1 + b_t^1 + \gamma_1 * D_{i,t-1} + \beta_1 * L_{i,t-1} + \delta_1 * x_{i,t-1} + \epsilon_{i,t}^1, \\
l_{i,t} &= a_i^2 + b_t^2 + \gamma_2 * L_{i,t-1} + \beta_2 * D_{i,t-1} + \delta_2 * x_{i,t-1} + \epsilon_{i,t}^2, \\
E\left(\epsilon_{i,t}^1, \epsilon_{i,t}^2 \middle| D_{i,t-k}, L_{i,t-k}, x_{i,t-k}\right) &= 0,
\end{aligned}
$$

where i indexes different firms, $i=1,\ldots,N$, t indexes different years, $t=1,\ldots,T$, k is the number of lags, $d_{i,t}$ is the change in the debt ratio from year $t-1$ to t, measuring the use of new debt, $l_{i,t}$ is the change in the lease ratio from year $t-1$ to t, measuring the use of new leases, $D_{i,t-1}$ is the existing debt ratio at the end of year $t-1$, $L_{i,t-1}$ is the existing lease ratio at the end of year $t-1$; a_i^1 and a_i^2 are dummy variables measuring the fixed effects of different firms, b_t^1 and b_t^2 are dummy variables measuring the fixed effects of different years, $x_{i,t-1}$ is a vector including all the control variables affecting corporate external financing costs, measured at year $t-1$, and $\epsilon_{i,t}^1$ and $\epsilon_{i,t}^2$ are error terms.

To simultaneously control for endogeneity problems and firms' fixed effects, I use the generalized method of moments (GMM) technique developed in Arellano and Bond (1991) and Arellano and Bover (1995).[11] First, I take the first-difference transformation to eliminate firms' fixed effects a_i^1 and a_i^2 in model (5),

$$
\begin{aligned}
(6) \qquad \Delta d_{i,t} &= \Delta b_t^1 + \gamma_1 * \Delta D_{i,t-1} + \beta_1 * \Delta L_{i,t-1} + \delta_1 * \Delta x_{i,t-1} + \Delta\epsilon_{i,t}^1, \quad \text{and} \\
\Delta l_{i,t} &= \Delta b_t^2 + \gamma_2 * \Delta L_{i,t-1} + \beta_2 * \Delta D_{i,t-1} + \delta_2 * \Delta x_{i,t-1} + \Delta\epsilon_{i,t}^2.
\end{aligned}
$$

Then, I control for endogeneity problems by using suitably lagged explanatory variables $\{D_{i,t-k}, L_{i,t-k}, x_{i,t-k}\}$, where $k \geq 3$, as the instrumental variables (IVs) for the explanatory variables in model (6) (i.e., $\Delta D_{i,t-1}$, $\Delta L_{i,t-1}$, and $\Delta x_{i,t-1}$). Table 2 presents all the possible IVs for the debt equation in model (6) if ϵ_{it}^1 is serially uncorrelated.

TABLE 2

Choices of Instrumental Variables

Equations	IVs Available
$\Delta d_{i,4} = \Delta b_4^1 + \gamma_1 * \Delta D_{i,3} + \beta_1 * \Delta L_{i,3} + \delta_1 * \Delta x_{i,3} + \Delta\epsilon_{i,4}^1$	$D_{i,1}, L_{i,1}, x_{i,1}$
$\Delta d_{i,5} = \Delta b_5^1 + \gamma_1 * \Delta D_{i,4} + \beta_1 * \Delta L_{i,4} + \delta_1 * \Delta x_{i,4} + \Delta\epsilon_{i,5}^1$	$D_{i,t}, L_{i,t}, x_{i,t}$; $t = 1, 2$
.	.
$\Delta d_{i,T} = \Delta b_T^1 + \gamma_1 * \Delta D_{i,T-1} + \beta_1 * \Delta L_{i,T-1} + \delta_1 * \Delta x_{i,T-1} + \Delta\epsilon_{i,T}^1$	$D_{i,t}, L_{i,t}, x_{i,t}$; $t = 1, \ldots, T-3$

However, in some circumstances, the error terms ϵ_{it}^1 and ϵ_{it}^2 may be serially correlated. If so, the instrumental variables chosen as above might be correlated with the error terms. To ensure an unbiased estimation, after each regression I test

[11] See also Arellano (1988) and Blundell and Bond (1998).

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to see if my choice of IVs is appropriate. For each set of instrumental variables, I first run regression (6) and then examine the first- and second-order, or even higher order, serial correlations in the first-differenced residuals (i.e., $\Delta\epsilon_{it}^{1}$ and $\Delta\epsilon_{i,t}^{2}$). If the disturbances ϵ_{it}^{1} and ϵ_{it}^{2} are serially uncorrelated, there should be evidence of negative and significant first-order serial correlation in the differenced residuals, but no evidence of second-order serial correlation. Otherwise, if ϵ_{it}^{1} and ϵ_{it}^{2} are serially correlated, both the first- and the second-order correlations or even higher order correlations in the differenced residuals will be significant.

I test the serial correlations based on the standardized average residual autocovariances, which are asymptotically $N(0,1)$ variables under the null hypothesis of no autocorrelation. In particular, if the test shows no second-order serial correlations in both $\Delta\epsilon_{it}^{1}$ and $\Delta\epsilon_{it}^{2}$, it suggests that both ϵ_{it}^{1} and ϵ_{it}^{2} are serially uncorrelated, and lagged variables with lag $k \geq 3$ (as shown in Table 2) are appropriate IVs. On the other hand, if the test indicates a second-order serial correlation in $\Delta\epsilon_{it}^{1}$ but no third-order serial correlation, it suggests that ϵ_{it}^{1} follows a first-order autocorrelation process, and only lagged variables with lag $k \geq 4$ can be used as IVs in the debt equation. That is, if the test indicates an nth-order but no higher order serial correlation in $\Delta\epsilon_{it}^{1}$ (or $\Delta\epsilon_{it}^{2}$), then it suggests that ϵ_{it}^{1} (or ϵ_{it}^{2}) follows an $AR(n-1)$ process. In this case, only lagged variables with lag $k \geq n+2$ are appropriate IVs.

Two-step GMM estimators are used in all the estimations, and significance tests are conducted using heteroskedasticity-consistent standard errors. In model (5), β_1 measures the relation between new debt and existing leases and β_2 measures the relation between new leases and existing debt. Following the discussions on $\partial d/\partial L$ and $\partial l/\partial D$ in the previous section, I reject the hypothesis that leases and debt are complements if either β_1 or β_2 is negative.

B. Data and Sample Selection

I construct a set of panel data from Standard and Poor's Compustat files. Included in the panel are annual observations from 1983–1997 for firms on the active files. Foreign incorporated companies are excluded. I also exclude financial industries with two-digit SIC codes equal to 60–69 and those industries where real property or natural resources constitute a large portion of a firm's assets, including petroleum refining, mining, agriculture, and fishery industries. I require that each firm in my sample have data for at least four years. After dropping observations with missing data for relevant variables, my sample contains 3,145 firms and 24,771 firm-year observations.

To measure a firm's operating lease ratio, I use the amount of operating leases scaled by adjusted book value. I define adjusted book value as the book value of total assets plus the amount of operating leases. I measure the amount of operating leases as the present value of current year rental expenses and rental commitments over the next five years (discounted at 10%).[12] Because my measurement

[12]This measure of operating leases may be biased downward because it implicitly assumes that lease contracts will last for at most five years. However, only the rental commitments for the next five years are available from Compustat. Alternatively, I could measure operating leases by comparing rental expenses with interest expenses and then inferring the portion of operating leases compared

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of operating leases could be biased if different firms have different costs on the leased capital, I also use an alternative measure of operating leases in which lease payments are discounted by firms' average short-term borrowing rates reported in Compustat.[13] Since the results are similar in both cases, I report only the results using a 10% discount rate. To further check the robustness of my results, I also use the perpetuity method and the depreciation-adjusted perpetuity method proposed in Lim, Mann, and Mihov (2004) to measure operating leases. I discuss the results based on these methods later in this section.

I measure the debt ratio as the book value of total debt net of capitalized leases scaled by adjusted book value, the long-term debt ratio as the book value of long-term debt minus the amount of capitalized leases scaled by adjusted book value, and the capitalized lease ratio as the amount of capitalized leases scaled by adjusted book value.

Table 3 presents the average debt ratios and lease ratios in each year from 1983 to 1997. Since both leases and debt represent fixed payment obligations, I also report the average usage of debt and leases as a fraction of total fixed claims, where total fixed claims consist of debt, capitalized leases, and operating leases. Table 3 indicates that the importance of capitalized leases in corporate external obligations has been lessening, in the sense that the proportion of capitalized leases in total corporate liabilities has been declining. In 1997, capitalized leases accounted on average for only about 0.7% of a firm's adjusted book value and 1.3% of a firm's total external obligations. Compared with capitalized leases, operating leases consistently account for a significant portion of a firm's external financing. On average, operating leases account for around 10% of a firm's adjusted book value and around 20% of a firm's external obligations. Due to the diminishing importance of capitalized leases, I focus only on operating leases to investigate the interaction between leases and debt.[14] By focusing on operating leases, I can also ensure that tax arbitrage could be part of a firm's consideration in choosing between leases and debt. As noted earlier, a firm can trade tax shields to a lessor in exchange for a better price on its lease. However, tax arbitrage can be accomplished only in true (tax) leases. According to Graham, Lemmon, and Schallheim (1998), operating leases are most likely to be true leases while capitalized leases are most probably a mixture of true and non-true leases. Finally, many firms have no capitalized leases. Therefore, by ignoring capitalized leases, I can avoid complications involving the control for endogeneity in a tobit model.

C. Construction of Control Variables

I choose control variables for my regressions as follows. First, asymmetric information theories (e.g., Myers and Majluf (1984)) suggest that a firm could

with the other fixed claims. However, this measure would be biased upward because, from an accounting perspective, rental expenses are equivalent to interest expenses plus principal paid each year. Therefore, I use the present value measure instead of the latter measure.

[13]There are many missing values for the short-term borrowing rates. I use the average borrowing rates of firms with the same bond rating to approximate those missing values.

[14]Total leases, including both operating leases and capitalized leases, are constructed as well to test the relation between total leases and debt. The results based on total leases are similar to those based only on operating leases.

TABLE 3

Lease Ratios and Debt Ratios (mean values 1983–1997)

In Panel A, the debt ratio is calculated as the book value of total debt net of the amount of capitalized leases divided by adjusted book value. Adjusted book value is calculated as the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The long-term debt ratio is the amount of long-term debt net of the amount of capitalized leases divided by adjusted book value. The capitalized lease ratio and operating lease ratio are the amounts of capitalized leases and operating leases divided by adjusted book value, respectively. In Panel B, similar ratios are calculated, except that the denominator uses the amount of total fixed claim obligations including debt, operating leases, and capitalized leases, instead of adjusted book value.

Year	No. of Obs.	Capitalized Lease Ratio	Operating Lease Ratio	Debt Ratio	Long-Term Debt Ratio
Panel A. Denominator: Adjusted Book Value					
1983	609	0.023	0.079	0.400	0.119
1984	910	0.025	0.091	0.404	0.125
1985	997	0.025	0.092	0.403	0.127
1986	1,137	0.024	0.094	0.410	0.135
1987	1,262	0.024	0.099	0.419	0.138
1988	1,302	0.023	0.101	0.424	0.135
1989	1,399	0.022	0.102	0.435	0.140
1990	1,474	0.021	0.104	0.427	0.133
1991	1,630	0.020	0.102	0.406	0.121
1992	1,866	0.019	0.101	0.397	0.119
1993	2,155	0.017	0.097	0.392	0.115
1994	2,378	0.010	0.097	0.406	0.124
1995	2,623	0.008	0.096	0.412	0.131
1996	2,620	0.008	0.096	0.415	0.133
1997	2,409	0.007	0.099	0.421	0.142
Total	2,4771	0.016	0.097	0.412	0.129
Panel B. Denominator: Total Fixed Claims					
1983	609	0.048	0.182	0.209	0.770
1984	910	0.049	0.190	0.209	0.761
1985	997	0.047	0.191	0.216	0.762
1986	1,137	0.044	0.192	0.223	0.763
1987	1,262	0.045	0.195	0.223	0.760
1988	1,302	0.043	0.195	0.216	0.761
1989	1,399	0.040	0.194	0.218	0.766
1990	1,474	0.039	0.199	0.207	0.762
1991	1,630	0.040	0.206	0.193	0.755
1992	1,866	0.038	0.211	0.189	0.751
1993	2,155	0.036	0.209	0.185	0.755
1994	2,378	0.022	0.202	0.203	0.777
1995	2,623	0.016	0.198	0.213	0.786
1996	2,620	0.014	0.197	0.218	0.788
1997	2,409	0.013	0.198	0.229	0.790
Total	24,771	0.031	0.199	0.770	0.209

be mispriced due to the asymmetric information between a firm's insiders and the capital market. Given that debt and leases are less underpriced than equity, a higher valued firm suffering from more information asymmetry will issue more debt or leases, and less equity. To account for this argument, I follow Barclay and Smith (1995) and use a firm's abnormal earnings as a proxy for the quality of the firm. Based on the assumption that earnings follow a random walk, I measure abnormal earnings in year t by the difference between earnings per share in year t and earnings per share in year $t + 1$, divided by the share price in year t. I also construct a dummy variable equal to one for non-dividend-paying firms, and zero otherwise, as a proxy for the extent of asymmetric information problems, since firms that pay no cash dividends are likely to be among those most burdened by high asymmetric information costs. Firm size is another proxy that may indicate the quality of outsiders' information, as a large firm faces less severe asymmetric

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information than does a small firm. I measure firm size using both the log of the number of employees and the log of the book value of assets. [15]

A firm will invest as long as the marginal expected profitability on its investment exceeds the cost of its external funds. This investment pattern implies that firms with more growth options will use more external financing. On the other hand, Myers (1977) suggests that firms with more growth options should use less debt financing to avoid underinvestment arising from "debt overhang." I use the market-to-book ratio to proxy for a firm's investment opportunity set, where the market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. A firm's financial constraint might affect its external financing policy as well. All else equal, a larger amount of cash flows can not only enhance a firm's debt capacity, but also reduce its need of external funds. I measure a firm's cash flows by using operating income before interest, depreciation, rent, and taxes, deflated by the book value of assets. Since firms that pay no cash dividends are more likely to be burdened by severe financial constraints, the no-dividend-paying dummy can also serve as a proxy for the severity of financial constraint. Further, the availability of collateral may affect a firm's financing policy since fixed assets are more valuable in liquidations and can support a higher external obligation capacity. I use a firm's fixed assets to measure the availability of the firm's collateral, where the availability of fixed assets is measured as the amount of net property, plant, and equipment, scaled by the book value of assets. Finally, to account for tax effects, I use the before financing marginal tax rates as provided in Lemmon, Graham, and Schallheim (1998). [16]

Table 4 presents sample statistics with respect to operating leases, long-term debt, and the control variables. Panel A reports the sample means of all the variables. Panel B reports the correlations between the change in operating leases and the control variables, as well as the correlations between the change in long-term debt and the control variables. Panel C reports the correlations among all the control variables.

According to Table 4, the change in long-term debt is positively related to existing operating leases. This positive relation seems to suggest that leases and debt are complements. However, this pair-wise correlation may be a biased estimate of the relation between leases and debt, since it does not properly control for the factors that are simultaneously correlated with both the debt and lease variables. Therefore, further investigation with appropriate control for endogeneity is needed. Table 4 also shows that both existing leases and existing debt are correlated with firm size, the market-to-book ratio, the no-dividend dummy, and the before financing marginal tax rate. These correlations suggest that appropriate control of these variables is important to obtain unbiased estimations.

[15] These two size variables are highly correlated. Dropping either one of the two variables from the regressions does not qualitatively change my results on the relation between leases and debt.

[16] I thank John Graham for providing me with the data on marginal tax rates.

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TABLE 4

Sample Statistics

Table 4 presents sample statistics including means and correlations. Long-term debt is the amount of long-term debt minus the amount of capitalized leases. Operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The no-dividend dummy is equal to one if a firm pays no dividends and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the sum of the book value of debt and the market value of equity dividend by the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share, divided by the current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes. Employment is the number of employees. Total assets is the book value of assets. Numbers denoted with an asterisk (*) are significant at the 1% level.

	Long-Term Debt ($ mill.)	Operating Leases ($ mill.)	Market-to-Book Ratio	No-Dividend	Marginal Tax Rate	Abnormal Earnings	Operating Income ($ mill.)	Employ-ment (thousands)	Total Assets ($ mill.)	Property, Plant, & Equip. ($ mill.)
Panel A. Sample Means										
Means	253.94	80.28	2.015	0.611	0.282	–0.044	172.04	9.25	1252.05	448.58
Panel B. Correlations of Changes in Debt and Leases with Control Variables										
Change in long-term debt	0.460*	0.198*	–0.016*	–0.071*	0.036*	0.002	0.303*	0.302*	0.378*	0.286*
Change in operating leases	0.261*	0.462*	–0.014*	–0.084*	0.065*	0.0005	0.232*	0.277*	0.240*	0.268*
Panel C. Correlations among Control Variables										
Long-term debt	—									
Operating leases	0.603*	—								
Market-to-book ratio	–0.046*	–0.045*	—							
No-dividend	–0.198*	–0.207*	0.128*	—						
Before financing marginal tax rate	0.093*	0.110*	–0.272*	–0.359*	—					
Abnormal earnings	0.018*	0.019*	0.016	–0.081*	0.044*	—				
Operating income	0.796*	0.651*	–0.026*	–0.242*	0.119*	0.005	—			
Employment	0.692*	0.704*	–0.048*	–0.268*	0.148*	0.029*	0.460*	—		
Total assets	0.937*	0.621*	–0.035*	–0.192*	0.088*	0.019*	0.851*	0.504*	—	
Property, plant, & equip.	0.794*	0.657*	–0.045*	–0.244*	0.113	0.014*	0.900*	0.726*	0.795*	—

D. Empirical Results

1. Substitutability versus Complementarity

Tables 5 and 6 report the results from the estimations on the debt and lease equations in model (5). The difference between Tables 5 and 6 is that Table 5 reports the relation between operating leases and long-term debt, whereas Table 6 reports the relation between operating leases and total debt.

I include both time and firm dummies in the regressions to control for different patterns across times and across firms. Instrumental variables include the lag variables of all the explanatory variables, and are selected as discussed earlier. In particular, after each GMM estimation, the serial correlations of first-differenced residuals are tested to ensure that the IVs and error terms are uncorrelated. For

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TABLE 5

Substitutability between Long-Term Debt and Operating Leases

Table 5 reports the results from two-step GMM estimations on the relation between long-term debt and operating leases. The dependent variable is the change in the long-term debt ratio in column (I) and the change in the operating lease ratio in column (II). The instrumental variables in the debt regression include the explanatory variables lagged by three and four years and the instrumental variables in the lease regression include the explanatory variables lagged by six and seven years. The test results on the serial correlations of the differenced residuals are provided below the table. For the explanatory variables, the long-term debt ratio is calculated as the amount of long-term debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The operating lease ratio is the value of operating leases scaled by adjusted book value. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by the current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. The first- to the third-order serial correlations in the first-differenced residuals from regression (I) are insignificantly different from zero and they are not reported below. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	(I) Change in Long-Term Debt Ratio[a]		(II) Change in Operating Lease Ratio[b]	
Explanatory Variables	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Long-term debt ratio	−0.618***	−6.250	−0.015*	−1.850
Operating lease ratio	−0.368**	−2.028	−0.513***	−13.868
Market-to-book ratio	0.002	0.680	0.00001	0.029
Employment	−0.005	−0.173	−0.003	−0.784
No-dividend	0.008	0.256	−0.001	−0.421
Marginal tax rate	0.057	0.642	−0.023*	−1.697
Abnormal earnings	−0.001	−0.032	−0.005**	−2.141
Operating income	−0.121**	−2.141	0.006	0.973
Total assets	0.035	1.111	0.003	0.719
Property, plant, & equipment	0.042	0.527	−0.021	−1.544

[a]Test for fourth-order serial correlation: −6.157 $p = 0.000$
Test for fifth-order serial correlation: 1.495 $p = 0.135$
[b]Test for first-order serial correlation: −9.786 $p = 0.000$
Test for second-order serial correlation: −0.852 $p = 0.394$

example, for the regression reported in column (I) of Table 5, I first include the independent variables lagged by more than three years as the IVs. However, the test on the differenced residuals from this regression shows a significant second-order serial correlation, which indicates that the independent variables lagged by three years are inappropriate IVs. Then I try the independent variables lagged by more than four, five, or more years as the IVs until the tests on the differenced residuals support my choice of IVs.

According to the hypothesis of complements, both β_1 and β_2 in model (5) are expected to be positive. However, I find that β_1, the impact of operating leases on new debt, is significant and negative. This result holds whether I use long-term debt or total debt in the regressions. In specification (I), where the change in the long-term debt ratio is used as the dependent variable, β_1 is equal to -0.368 and is significant at the 5% level (with a *t*-statistic equal to -2.03). The tests on the differenced residuals of this regression show significant serial correlations from the first order to the fourth order, but no significant fifth-order serial correlation (which reports a *p*-value of 0.135). These test results suggest that the explanatory variables lagged by more than six years are uncorrelated with error terms. Thus, my choice of using the explanatory variables lagged by six and seven years as the

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TABLE 6

Substitutability between Total Debt and Operating Leases

Table 6 reports the results from two-step GMM estimations on the relation between total debt and operating leases. The dependent variable is the change in the total debt ratio in column (III), and the change in the operating lease ratio in column (IV). The instrumental variables in both regressions include the explanatory variables lagged by three and four years. The test results on the first- and second-order serial correlations of the differenced residuals are provided below the table. For the explanatory variables, the total debt ratio is calculated as the amount of total debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The operating lease ratio is the value of operating leases scaled by adjusted book value. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	(III) Change in the Total Debt Ratio[a]		(IV) Change in the Operating Lease Ratio[b]	
Explanatory Variables	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Total debt ratio	−0.348***	−12.310	0.005	0.650
Operating lease ratio	−0.266***	−2.717	−0.519***	−14.207
Market-to-book ratio	−0.002	−1.290	0.0003	0.686
Employment	0.029*	1.864	−0.005	−1.273
No-dividend	−0.016	−1.448	−0.003	−1.077
Marginal tax rate	0.002	0.040	−0.019	−1.394
Abnormal earnings	−0.008	−0.848	−0.005**	−2.196
Operating income	−0.030*	−1.892	0.006	0.978
Total assets	−0.017	−1.000	0.005	1.072
Property, plant, & equipment	0.081*	1.730	−0.020	−1.427

[a]Test for first-order serial correlation: −7.523 $p = 0.000$
Test for second-order serial correlation: 1.306 $p = 0.192$
[b]Test for first-order serial correlation: −9.592 $p = 0.000$
Test for second-order serial correlation: −0.878 $p = 0.380$

IVs is justified.[17] Similarly, in specification (III), where the change in the total debt ratio is the dependent variable, β_1 is equal to -0.266 and is significant at the 1% level (with a *t*-statistic equal to -2.72). In this regression, I choose the explanatory variables lagged by three and four years as the IVs. This choice of IVs is justified, since my tests on the differenced residuals show a significant first-order serial correlation, but an insignificant second-order serial correlation. Thus, the results from both specifications reject the hypothesis that leases and debt are complements, but cannot reject that they are substitutes.

The results on β_2, the impact of existing debt on new operating leases, also support the hypothesis of substitutes. In specification (II), where the lagged long-term debt ratio is used to measure existing debt, β_2 is negative and is significant at the 10% level. This result rejects the hypothesis of complements. However, in specification (IV), where the lagged total debt ratio is used to measure existing debt, β_2 is insignificant. This result is consistent with both the hypothesis of substitutes and the hypothesis of complements.

In summary, the above empirical results generally support the hypothesis that leases and debt are substitutes, but reject the hypothesis that they are complements.

[17]I choose not to use the explanatory variables lagged by more than seven years as the IVs since doing so would significantly reduce the sample size in the regression.

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2. Robustness of Results

In this section, I construct two tests to check the robustness of the empirical results presented in the previous section. In the first robustness check, I use an alternative measure of operating leases as proposed in Lim, Mann, and Mihov (2004). I measure the amount of operating leases as the average of current rental expenses and next year's minimum lease payments, discounted at the cost of debt.[18] I try both 10% and firms' average short-term borrowing rates reported in Compustat as the cost of debt. Since the results in both cases are similar, I report only the results from the case with 10% as the cost of debt.

I run regressions under the same specifications as those in Table 6. The results are reported in Table 7. As expected, both the coefficient of the operating lease ratio in the debt equation, β_1, and the coefficient of the debt ratio in the lease equation, β_2, are negative and significant at the 1% level. These results also support the hypothesis that debt and leases are substitutes, while rejecting the hypothesis of complements.

TABLE 7

Robustness Test: Using Alternative Measure of Operating Leases

Table 7 reports the results from two-step GMM estimations on the relation between debt and leases, using an alternative measure of operating leases. The dependent variables are the change in the total debt ratio and the change in the operating lease ratio, respectively. The instrumental variables in the debt regression include the explanatory variables lagged by three and four years and the instrumental variables in the lease regression include the explanatory variables lagged by five and six years. The test results on the serial correlations of the differenced residuals are provided below the table. For the explanatory variables, the total debt ratio is calculated as the amount of total debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is calculated using the perpetuity method proposed in Lim, Mann, and Mihov (2004). The operating lease ratio is the value of operating leases scaled by adjusted book value. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. The first- and the second-order serial correlations in the first-differenced residuals from the lease regression are insignificantly different from zero. They are not reported in the table. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	Change in the Total Debt Ratio[a]		Change in the Operating Lease Ratio[b]	
Explanatory Variables	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Total debt ratio	−0.294***	−11.506	−0.054***	−2.594
Operating lease ratio	−0.247***	−2.998	−0.439***	−5.530
Market-to-book ratio	−0.002	−1.525	−0.0029***	−3.461
Employment	0.035***	2.563	−0.026***	−2.799
No-dividend	−0.015	−1.454	0.001	0.081
Marginal tax rate	0.041	0.930	−0.056*	−1.697
Abnormal earnings	−0.010	−1.206	0.012*	1.648
Operating income	−0.026*	−1.875	−0.004	−0.183
Total assets	−0.027*	−1.843	0.030***	3.036
Property, plant, & equipment	0.079*	1.823	−0.021	−0.599

[a]Test for first-order serial correlation: −17.672 $p = 0.000$
Test for second-order serial correlation: 1.558 $p = 0.119$
[b]Test for third-order serial correlation: −11.249 $p = 0.000$
Test for fourth-order serial correlation: −1.650 $p = 0.101$

[18]I also use the depreciation-adjusted perpetuity method proposed in Lim, Mann, and Mihov (2004) to measure operating leases. The results based on this method are not quantitatively different from the results reported in the paper.

My second robustness test is on the two regressions reported in Table 6. Note that I run the two regressions with the same IVs for both the debt and lease equations. Thus, if both the change in debt and the change in leases are the same in equilibrium, then the debt and lease equations could be unidentified with the same set of IVs. However, according to Table 4, on average both the change in debt and the change in leases are positive and significantly different from each other, which excludes this possibility of unidentification.

To further address this identification concern, I rerun the two regressions in Table 6, using different instrumental variables. In particular, I use predetermined variables lagged by more than four years as the IVs in the debt equation and predetermined variables lagged by more than five years as the IVs in the lease equation. The results are presented in Table 8. As expected from the hypothesis of substitutes, I find a significantly negative β_1 and an insignificant β_2. These findings are similar to those reported in Table 6. Here, I choose not to rerun the regressions in Table 5 where different IVs are used in the debt and lease regressions.

TABLE 8

Robustness Test: Choosing Alternative Instrumental Variables

Table 8 reports the results from two-step GMM estimations on the relation between debt and leases, using different instrumental variables in debt and lease regressions. The dependent variables are the change in the total debt ratio and the change in the operating lease ratio, respectively. The instrumental variables in the debt regression include the explanatory variables lagged by three and four years and the instrumental variables in the lease regression include the explanatory variables with lags larger than five years. The test results on the serial correlations of the differenced residuals are provided below the table. The explanatory variables are calculated as follows. The total debt ratio is the amount of total debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The operating lease ratio is the value of operating leases scaled by adjusted book value. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. The first- and the second-order serial correlations in the first-differenced residuals from the lease regression are insignificantly different from zero. They are not reported in the table. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	Change in the Total Debt Ratio[a]		Change in the Operating Lease Ratio[b]	
Explanatory Variables	Coefficient	*t*-Statistic	Coefficient	*t*-Statistic
Total debt ratio	−0.332***	−9.907	−0.002	−0.166
Operating lease ratio	−0.350***	−3.001	−0.566***	−11.456
Market-to-book ratio	−0.001	−0.770	−0.0009	−1.593
Employment	0.011	0.628	−0.005	−1.023
No-dividend	−0.031*	−1.953	0.004	0.778
Marginal tax rate	0.014	0.219	0.002	0.080
Abnormal earnings	0.010	0.969	0.004	0.936
Operating income	−0.041*	−1.673	−0.016	−1.460
Total assets	−0.012	−0.653	0.004	0.619
Property, plant, & equipment	0.075	1.204	−0.022	−1.023

[a]Test for first-order serial correlation: −16.044 $p = 0.000$
Test for second-order serial correlation: 1.092 $p = 0.275$
[b]Test for third-order serial correlation: −7.820 $p = 0.000$
Test for fourth-order serial correlation: −0.453 $p = 0.651$

3. Sensitivity of Substitutability

In this section, I investigate the variation in the substitutability between leases and debt in different firms. Three firm characteristics are examined: divi-

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dend policy, investment opportunity set, and taxes. Only the results on the change in total debt ratio are presented.[19]

To investigate the effect of dividend policy, I run the regression,

$$
\begin{aligned}
(7) \qquad d_{i,t} \;=\; & a_i + b_t + \gamma_1 * dm * D_{i,t-1} + \beta_1 * dm * L_{i,t-1} \\
& + \gamma_1' * (1 - dm) * D_{i,t-1} + \beta_1' * (1 - dm) * L_{i,t-1} \\
& + \delta_1 * x_{i,t-1} + \epsilon_{i,t}.
\end{aligned}
$$

In the study on the impact of dividend policy, *dm* is a dummy variable equal to one if a firm pays no dividends and zero otherwise.

Similarly, a two-step GMM estimation is used. Table 9 reports the results. I find that for firms that pay no dividends to their shareholders, the coefficient on the operating lease ratio, β_1, is negative and significant (-0.336 with a *t*-statistic of -3.16); for firms that pay dividends, the coefficient on the operating lease ratio, $\beta_1^{'}$, is insignificant (0.113 with a *t*-statistic of 0.51). These results suggest that the substitutability between leases and debt is more pronounced in firms that pay no dividends to their shareholders, i.e., an extra amount of leases increases the marginal cost of debt to a greater degree in these firms.

TABLE 9

Substitutability between Leases and Debt Related to Dividend Policy

Table 9 presents the results from testing the hypothesis that the substitutability between leases and debt is more pronounced in firms paying no dividends to shareholders. A GMM two-step estimation is used. The dependent variable is the change in the total debt ratio. The instrumental variables include the explanatory variables lagged by three and four years. The test results on the first- and second-order serial correlations of the differenced residuals are provided below the table. The explanatory variables are calculated as follows. The total debt ratio is the amount of total debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The operating lease ratio is the value of operating leases scaled by adjusted book value. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	Change in the Total Debt Ratio	
Explanatory Variables	Coefficient	*t*-Statistic
Total debt ratio ∗ no-dividend dummy	−0.422***	−10.503
Operating lease ratio ∗ no-dividend dummy	−0.336***	−3.158
Total debt ratio ∗ (1 − No-dividend dummy)	−0.137	−1.563
Operating lease ratio ∗ (1 − No-dividend dummy)	0.113	0.510
Market-to-book ratio	−0.0014	−0.896
Employment	0.039**	2.322
Marginal tax rate	0.019	0.374
No-dividend dummy	0.140***	2.514
Abnormal earnings	−0.010	−1.033
Operating income	−0.034**	−1.991
Total assets	−0.021	−1.150
Property, plant, & equipment	0.108**	2.218

Test for first-order serial correlation:	−17.614	$p = 0.000$
Test for second-order serial correlation:	1.502	$p = 0.133$

[19]Replacing the change in the total debt ratio with the change in the long-term debt ratio will yield results similar to those presented in the paper.

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A firm's dividend policy can serve as a proxy for information asymmetry between a firm's insiders and the market. A firm suffering more from asymmetric information problems is less likely to pay dividends to its shareholders. Thus, my results on the effect of dividend policy are consistent with the asymmetric information hypothesis discussed in Section II, suggesting that the substitutability between debt and leases is more pronounced in firms that face a greater degree of asymmetric information.

Now I test the effect of a firm's investment opportunity set on the substitutability between leases and debt. The results are reported in Table 10. I use the market-to-book ratio as a proxy for a firm's investment opportunity set. I use model (7) in the regression, where the dummy variable *dm* is constructed to be equal to one if a firm's market-to-book ratio is above the average market-to-book ratio of all the firms in my sample, and zero if it is below the average. According to Table 10, β_1 is negative and significant at the 5% level (-0.233 with a *t*-statistic of -2.24), and $\beta_1^{'}$ is insignificant (-0.154 with a *t*-statistic of -1.46). These results support the agency cost hypothesis discussed in Section II. They suggest that the substitutability between leases and debt is more pronounced in firms with more investment opportunities, i.e., an extra amount of leases increases the marginal cost of debt to a greater degree in those firms with more growth options.

TABLE 10

Substitutability between Leases and Debt Related to Investment Opportunity Set

Table 10 presents the results from testing the hypothesis that the substitutability between leases and debt is more pronounced in firms with more growth options. A GMM two-step estimation is used. The dependent variable is the change of total debt ratio. The instrumental variables include the explanatory variables lagged by three and four years. The test results on the first- and second-order serial correlations of the differenced residuals are provided below the table. The explanatory variables are calculated as follows. The total debt ratio is the amount of total debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The operating lease ratio is the value of operating leases scaled by adjusted book value. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The dummy of the large market-to-book ratio is equal to one if a firm's market-to-book ratio is above the average market-to-book ratio of all the firms in the sample. The dummy of the small market-to-book ratio is equal to one if a firm's market-to-book ratio is below the average market-to-book ratio. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	Change in the Total Debt Ratio	
Explanatory Variables	Coefficient	*t*-Statistic
Total debt ratio $*$ dummy of large market-to-book ratio	-0.450***	-10.255
Operating lease ratio $*$ dummy of large market-to-book ratio	-0.233**	-2.235
Total debt ratio $*$ dummy of small market-to-book ratio	-0.280***	-8.438
Operating Lease RATIO $*$ dummy of small market-to-book ratio	-0.154	-1.464
Market-to-book ratio	-0.001	-0.709
Employment	0.021	1.376
Marginal tax rate	-0.003	-0.061
No-dividend	-0.015	-1.273
Abnormal earnings	-0.007	-0.716
Operating income	-0.019	-1.212
Total assets	-0.029*	-1.653
Property, plant, & equipment	0.079*	1.630
Test for first-order serial correlation: -17.915	$p = 0.000$	
Test for second-order serial correlation: 0.925	$p = 0.355$	

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Finally, I test the effect of a firm's marginal tax rate on the substitutability between leases and debt. The results are reported in Table 11. Again, I use model (7). I construct the dummy variable *dm* so that it is equal to one if a firm's before financing marginal tax rate is above the average tax rate of all the firms in my sample, and zero if it is below the average. According to Table 11, β_1 is negative and significant at the 1% level (-0.27 with a *t*-statistic of -2.65) and β_1' is insignificant (-0.127 with a *t*-statistic of -0.99). These results support the tax hypothesis discussed in Section II. They suggest that the substitutability between leases and debt is more pronounced in firms with high marginal tax rates, i.e., the cost of debt increases by an extra amount of leases to a greater degree in those firms with high marginal tax rates.

TABLE 11

Substitutability between Leases and Debt Related to Marginal Tax Rates

Table 11 presents the results from testing the hypothesis that the substitutability between leases and debt is more pronounced in firms with higher marginal tax rates. A GMM two-step estimation is used. The dependent variable is the change in the total debt ratio. The instrumental variables include the explanatory variables lagged by three and four years. The test results on the first- and second-order serial correlations of the differenced residuals are provided below the table. The explanatory variables are calculated as follows: the total debt ratio is the amount of total debt minus the amount of capitalized leases scaled by adjusted book value. Adjusted book value is the book value of total assets plus the value of operating leases, where the value of operating leases is the present value of current year rental expenses plus rental commitments over the next five years (discounted at 10%). The operating lease ratio is the value of operating leases scaled by adjusted book value. The dummy of the high tax rate is equal to one if a firm's before financing marginal tax rate is above the average tax rate of all the firms in the sample. The dummy of the low tax rate is equal to one if a firm's before financing marginal tax rate is below the average tax rate. The no-dividend dummy is equal to one if a firm pays no dividends, and zero otherwise. The before financing marginal tax rate is borrowed from Lemmon, Graham, and Schallheim (1998). The market-to-book ratio is the ratio of the sum of the book value of debt and the market value of equity to the book value of total assets. Abnormal earnings is current earnings per share minus next year's earnings per share divided by current share price. Operating income is defined as operating income before interest, depreciation, rent, and taxes, scaled by the book value of assets. Employment is the log of the number of employees. Total assets is the log of the book value of assets. Property, plant, and equipment is scaled by the book value of assets. Both time effects and firms' fixed effects are controlled for but not reported. *, **, and *** indicate significant difference at the 10%, 5%, and 1% levels, respectively.

	Change in the Total Debt Ratio	
Explanatory Variables	Coefficient	*t*-Statistic
Total debt ratio ∗ dummy of high tax rate	−0.337***	−10.081
Operating lease ratio ∗ dummy of high tax rate	−0.270***	−2.651
Total debt ratio ∗ dummy of low tax rate	−0.436***	−9.891
Operating lease ratio ∗ dummy of low tax rate	−0.128	−0.987
Market-to-book ratio	−0.0018	−1.158
Employment	0.031**	1.999
No-dividend	−0.013	−1.095
Marginal tax rate	0.002	0.031
Abnormal earnings	−0.004	−0.382
Operating income	−0.022	−1.266
Total assets	−0.019	−1.090
Property, plant, & equipment	0.111***	2.205
Test for first-order serial correlation:	−16.968	$p = 0.000$
Test for second-order serial correlation:	1.044	$p = 0.297$

IV. Conclusion

This paper examines the relation between lease financing and debt financing. I first construct a model that relates the substitutability/complementarity between leases and debt to their marginal financing costs. I clarify that the substitutability between leases and debt arises from the fact that leases increase the marginal financing cost of debt or vice versa. I then test the hypothesis derived from the

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model, using a GMM technique that controls for both endogeneity problems and firms' fixed effects. My results reject the hypothesis that leases and debt are complements, but cannot reject the hypothesis that they are substitutes. Further, I investigate the variation in the substitutability between leases and debt across different firms. I find that the degree of substitutability between leases and debt is greater in firms that pay no dividends, in firms with more investment opportunities, or in firms with higher marginal tax rates. My findings are consistent with the asymmetric information, agency costs, and tax hypotheses, respectively.

Appendix. Numerical Examples on Asymmetric Information and Financing Cost

I consider here only the explicit cost of external financing and ignore the implicit costs such as the cost of financial distress. Consider a firm planning to invest \$10 million in a new project. The firm has zero internal capital, so it decides to borrow \$10 million junior debt to finance the project. There are two potential firm types: type G or type B. The type G firm can generate a net cash flow of \$50 million from the project, while the type B firm can generate only \$10 million. To start with, consider a benchmark case without asymmetric information. In this case, the type G firm would incur a constant financing cost of \$10 million, i.e., $C_1 = \$10$ million, as long as the firm's existing deteriorated liability is less than \$40 million.

Now, suppose that firm type is private information to the firm itself. The market believes that a firm is of type G (or B) with 50% probability. In this case, type G's cost of financing the \$10 million debt is no longer constant with respect to existing liabilities.

First, consider the effect of asymmetric information on C_{11}. If the type G firm has \$5 million in deteriorated debt in place (i.e., $D = 5$), then its financing cost is $C_1 = \$15$ million. If the type G firm has \$10 million in existing (deteriorated) debt, its financing cost is $C_1 = \$20$ million. Clearly, $C_1(D = 10) > C_1(D = 5)$. Thus, in the case of asymmetric information, the type G firm's cost of debt financing increases with an increase in the amount of its existing deteriorated debt, i.e., $C_{11} > 0$.

Second, consider the effect of asymmetric information on C_{12}. If the type G firm has \$5 million in existing deteriorated leases but no debt, then its cost of financing new debt is $C_1(L = \$5) = \$15$. If the firm has \$10 million deteriorated leases, its cost of debt financing is $C_1(L = \$10) = \$20$. Thus, in the case of asymmetric information, the change in the marginal cost of new debt in response to an extra \$5 million existing leases $C_{12}(\Delta L = \$5) = C_1(L = \$10) - C_1(L = \$5) = \$5 > 0$.

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