The Value of Contractual Terms in Office Leases

by

Kevin T. Sheehan

B.S.E. Civil Engineering, Princeton University, 1997
J.D., University of Virginia, 2000

SUBMITTED TO THE DEPARTMENT OF ARCHITECTURE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN REAL ESTATE DEVELOPMENT
AT THE
MASSACHUSSETS INSTITUTE OF TECHNOLOGY

SEPTEMBER 2006

Signature of Author: _____

Department of Architecture
July 28, 2006

Certified by: _____

Henry O. Pollakowski
Principal Research Associate
Center for Real Estate

Accepted by: _____

David Geltner
Chairman, Interdepartmental Degree Program in Real Estate Development

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Submitted to the Department of Architecture
on July 28, 2006 in Partial Fulfillment of the
Requirements for the Degree of Master of Science in
Real Estate Development

Abstract

This paper uses a comprehensive data set to develop a hedonic model of office rent that estimates values of contractual terms such as tenant improvement allowances, leasing commissions, and options. The model includes variables to control for building characteristics and market conditions, as well as basic lease terms. Although other studies have used a similar approach, the prior work in this area was limited by the lack of data regarding contractual terms.

The results show that there is a consistent, upward-sloping, convex term structure of rent. Furthermore, there is an insignificant "size premium" but the "proportion discount" is significant. In general, other variables, such as location variables and qualitative variables behave as expected, with the exception of the expense type dummy variables.

Tenant improvement allowances and leasing commissions paid by the landlord do not have a predictable impact on rent at low levels. But high levels of allowances and commissions result in significant rent premiums. These results indicate that lower levels of allowances and commissions may be expected by the market. At higher levels, however, these contractual terms are clearly priced into rent levels.

Renewal options appear to have positive impacts in some years and negative impacts in other years. Renewal options may represent amenities that are granted to tenants as inducements in weaker leasing markets but are priced in stronger markets. Termination options and rights of first offer/refusal appear to have negative impacts on rent that are somewhat consistent in all years. This is counterintuitive because these options are thought to benefit the tenant. One explanation is that these options are in fact beneficial to the landlord.

Further study is necessary to understand the value of these options. Overall, more information about options terms would be beneficial. Information such as the renewal rent, the termination fee, and the size of the offer/refusal space would help us to understand the economic arrangement between the parties and to predict the corresponding impact on rent.

Thesis Supervisor: Henry O. Pollakowski
Title: Principal Research Associate, Center for Real Estate

Acknowledgements

Thank you to Lynn Fisher and Henry Pollakowski, who were excellent thesis advisors and spent a lot of time helping me understand and interpret summary statistics and regression results.

Thank you to Chris Fruy, Jeffrey Havsy and Walter Paige, who supported this project and answered numerous questions throughout the process.

Thank you to Meena Murugappan and Michael O'Young, who went the extra mile to gather additional data and were generous enough to share it with me.

And, most of all, thank you to Rebecca Perkins, my awesome wife, who encouraged me to quit work, attend MIT, and switch careers in the same year that she gave birth to our son Jack. There has never been a better woman.

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Chapter 1: Introduction

Background

Commercial office leases are intensely negotiated between landlord and tenant. Thousands of dollars in fees to attorneys, brokers, and consultants may be spent by both parties. The logical conclusion is that contractual terms in office leases must have some value.

The basic contractual terms include lease length and the amount of leased space. The prior literature has studied these basic terms, in addition to other determinants, such as building characteristics and market conditions. Some of the prior studies have included even more detail, such as expense structures and base rent escalation clauses.

Certain contractual terms, however, have not been studied. Some of these terms appear to have obvious economic consequences. For example, tenant improvement allowances are common in office leases. These provisions require the landlord to fund all or a portion of the build out of the leased space. Leasing commissions are another common contractual term. These commissions are payments to third parties, which may constitute a significant percentage of the value of the lease.

Both tenant improvement allowances and leasing commissions are upfront costs paid by the landlord. But how do these costs affect rent levels? Are higher upfront costs balanced out by increased future cash flow from rent, or are these terms treated as concessions that are awarded to desirable tenants or when the leasing market is weak?

Other interesting provisions that may have some economic value include the various types of lease options. Options are generally held by the tenant, but may be held by the landlord in some cases. Options come in many different varieties, but the basic option types can be categorized as renewal, termination, expansion and reduction options. In addition, rights of first offer and rights of first refusal represent other forms of option rights. Each of these option types may present unique issues to both the tenant and the landlord. Some options may be commonly negotiated and others may appear less frequently.

Options theory teaches that lease options have some positive value to the option holder. But do rent levels reflect this value? Are options treated as concessions? Or does the inclusion of certain option types indicate the existence of a particular negotiation dynamic or a special situation on the part of either the landlord or the tenant?

Literature Review

There has been a limited amount of research that applies hedonic analysis to office rents. Furthermore, many of the prior studies are constrained by a lack of data, especially with regard to contractual provisions, including economic terms such as concessions, allowances, and commissions, as well as lease options.

Wheaton and Torto (1994) use a data set that includes approximately 60,000 leases negotiated between 1979 and 1991, in 50 metropolitan areas. “Consideration rent” is the dependent variable. Consideration rent is the average (undiscounted) gross payment per square foot to be paid over the full term of the lease. This measure includes free rent and specified rent steps and percentage escalations, but does not include CPI adjustments or the cost of tenant improvements.

First, Wheaton and Torto use a semi-log form to estimate the hedonic equation within each metro area. The regression variables include square feet of lease, length of lease in years, and dummy variables for building height, building newness, and built to suit leases. In addition, dummy variables are created for expense types, years, and submarkets.

Second, Wheaton and Torto use the hedonic rent index to estimate equilibrium market rents based on vacancy and space absorption. Wheaton and Torto conclude that movements in the calculated indices are very consistent with theories about rent, vacancy and commercial leasing. The conclusion notes that periodic re-estimation of the hedonic rent equation based on new historical data is necessary to update the indices.

This paper is based on the approach in the first part of Wheaton and Torto. In addition to that study, other hedonic models of office rent have been developed using various measures of rent as the dependent variable and incorporating more or less detail with regard to lease, building, and market-specific information.

Brennan et al. (1984) focus on the Chicago CBD office market. This study develops a hedonic model that explains the variation in office rent per square foot. Brennan et al. determine that the log-linear form is the best regression model. This study includes explanatory variables at the lease level such as "loss factor" and vertical location, as well as building characteristics and location terms. The model explains more than 90% of the variation in the log of rent; however, the sample size is very small and is limited to a single market.

Glasscock et al. (1990) provide an empirical analysis of office building rents using data from a sample of office buildings in Baton Rouge, Louisiana, over a five-year period. The results of this study indicate that rent levels respond to the various factors in the expected manner. The dependent variable is average real rent per square foot for each building in each year. This study also examines the rent-vacancy adjustment process over time.

Benjamin et al. (1992) examine the choice between rent contracts with and without relocation provisions and the impact of relocation provisions on office rents. This study uses a switching simultaneous-equations model, with the choice of relocation rights (not rent levels) as the dependent variable. Benjamin et al. conclude that rents and certain other lease terms are important determinants of the choice of relocation rights, but tenant characteristics such as size and creditworthiness have only a marginal effect.

Mills (1992) presents a statistical analysis of 1990 office asking rents in the Chicago metropolitan area. A variety of amenities were included in the hedonic model, along with building characteristics and location variables. The model also included dummy variables to indicate the presence of certain lease terms. This study concludes that location variables are especially important, and that the use of first-year asking rent as the dependent variable produces regression results that are similar to the output based on net present value measures.

Bollinger, et al. (1998) estimate hedonic office rent models using quoted annual rental rates per square foot for a sample of buildings located in Atlanta from 1990 to 1996. This study controls for building characteristics and lease terms, in an effort to evaluate the impact of location variables such as wage rates, transport rates, and proximity to concentrations of of support services and office workers. Bollinger, et al. conclude that these location measures explain some of the spatial variation in office rent.

Colwell et al. (1998) apply hedonic analysis to Chicago area properties that sold from 1986 to 1993. This study estimates a transactions-based index based on sales prices rather than rents. Colwell et al. note that many of the prior office market studies have used imperfect measures of rent, which do not include adjustments for complicated concessions such as free rent and tenant improvement allowances. Among other things, the results of this study show that there is a substantial premium for office properties located within employment centers.

Dunse and Jones (1998) apply hedonic analysis to identify the significant determinants of asking rents in Glasgow, Scotland. This study includes a good explanation of hedonic analysis and a helpful review of previous office studies. Using methods based on the prior work, Dunse and Jones analyze a sample of 477 asking rents, and conclude that building age and location factors are the principal determinants of rents.

Gunnelin and Soderberg (2003) study the term structure of rents using empirical analysis applied to a sample of 861 office leases in commercial properties located in Stockholm, Sweden, during a boom-and-bust phase from 1977-1991. The estimated hedonic rent equation was also used to construct an office rental index, similar to the approach used by Wheaton and Torto (1994). Gunnelin and Soderberg observe a significant term structure in 7 out if 15 years studied, and they conclude that the term structure appears to predict future rents reasonably well.

Ryan (2005) examines the importance of access to light rail transit and highway systems in estimating office and industrial property rents. This study uses longitudinal data to conduct hedonic price analysis of 520 office properties and 500 industrial properties in the San Diego metropolitan area from 1986 to 1995. Ryan finds that access to highways is a significant factor in estimating office property rents.

In summary, the conclusions of the prior literature produce a general set of factors that appear to be determinants of office rents. At the market level, these factors include dummy variables for metropolitan statistical area (MSA) and transaction year, and continuous variables for market vacancy. Many of the prior studies, however, are limited to a single market, so there is no need to control for MSA. Also, some of the prior studies use market vacancy to generate a rental index over time, so vacancy is used to generate that index and is not used as part of the hedonic estimation.

At the building level, there are a variety of important factors. First, physical characteristics such as building square feet, number of floors, and age are often used. Second, the prior studies often include qualitative dummy variables that represent building class or specific amenities such as parking and retail establishments. Third, different types of location variables are used. Location variables may be distances based on GIS information, submarket dummy variables, or demographic information, such as office employment within one mile.

Finally, at the lease level, most of the prior literature examines the impact of lease square feet. Some of the prior work includes lease floor (vertical location) and lease length as predictive variables. In addition, some of the prior studies include dummy variables to indicate the type of expense structure (e.g., net, partial net, expense stop, or gross). However, as noted above, the prior studies generally do not include data with regard to contractual provisions, including economic terms such as concessions, allowances, and commissions, as well as lease options.

Statement of Problem

This paper uses a comprehensive data set to develop a hedonic model of office rent that estimates values of contractual terms such as tenant improvement allowances, leasing commissions, and options. The model includes variables to control for building characteristics and market conditions, as well as basic lease terms. Although other studies have used a similar approach, the prior work in this area was limited by the lack of data regarding contractual terms.

Chapter 2: Data

Description of Data

The primary data set used in this paper includes information about the terms of over 26,000 lease negotiations. The data set was generated from a large portfolio of office properties. The data set includes lease negotiations processed between 2001 and 2005. Over 90% of the lease negotiations are classified as office leases, with the remainder being ancillary uses such as retail and storage leases.

Each observation in the data set represents a lease negotiation. Lease negotiations may be new leases, or renewals, expansions/contractions, expirations or terminations of existing leases. As a result, multiple observations may correspond to a single lease, which is defined as a unique tenant/building combination.

For example, one entry may record the negotiation of a new lease, and subsequent entry may record the renewal of the same lease, perhaps upon different economic terms. Often, subsequent entries will record increases or decreases in the amount of leased space, as the tenant expands or contracts.

The primary data set includes the following information about each lease negotiation:

Table 1: Primary Lease Data

Variable	Description
Lease Number	Different number assigned to each unique building/tenant combination.
Business Unit Number	Different number assigned to each building.
Business Unit Name	Name of building.
Market	Name of metropolitan statistical area (MSA).
Tenant Name	Name of tenant.
Unit Number	Suite number.
Activity Type	Type of current lease activity (e.g., new lease, renewal, expansion/contraction, expiration, termination).
Start Date	Commencement date of initial lease document. One date per lease.
End Date	Expiration date of most recent lease document. One date per lease.
Date Executed	Date initial lease document was executed by landlord. One date per lease.
Date Received	Date current lease document was received by landlord.
Commencement Date	Commencement date of current lease document.
Term in Months	Term in months from commencement date to end date.
Original Square Feet	Leased space before current lease activity.
Renewal Square Feet	Leased space after current lease activity.
Lease Square Feet	Square feet subject to current lease activity.
Current Rent	Initial rent per square foot per year.

Average Rent	Average rent per square foot per year over term to be paid by tenant. Average rent calculation includes the effect of free rent concessions and future rent increases/decreases, as well as an estimate of operating expenses and taxes.
Free Rent	Free rent per square foot per year over term to be conceded by landlord (i.e., months of free rent × rent per square foot per month / lease term in years).
TI Allowance	Total tenant improvement allowance per square foot to be paid by landlord.
Affiliated Broker Commission	Total leasing commission per square foot to be paid by landlord.
Unaffiliated Broker Commission	Total leasing commission per square foot to be paid by landlord.
Tenant Rep Broker Commission	Total leasing commission per square foot to be paid by landlord.
Expense Type	Type of expense pass-through (e.g., full net, net electric, base year, gross).
Lease Type	Type of lease (e.g., office, retail, storage, etc.).

In addition to the primary lease data, a second data set with information about lease options was obtained. The following table describes the lease option types:

Table 2: Lease Option Types

Variable	Description
Renewal Option	The right to renew an existing lease. Terms include exercise timeframe and renewal rent. Renewal rent is sometimes specified but is often defined as fair market rent or prevailing market rent.
Termination Option	The right to terminate an existing lease. Terms include exercise timeframe and cancellation fee. Cancellation fee may include unamortized portion of concessions, allowances, and commissions, in addition to a specified fee, often based on a multiple of monthly rent.
Expansion Option	The right to lease more space. Terms include identification of space, exercise timeframe, and expansion rent. Terms may also include free rent concessions and tenant improvement allowances for new space.
Contraction Option	The right to lease less space. Terms include identification of space, exercise timeframe, and contraction fee. Contraction fee similar to termination option cancellation fee applied to contraction space on pro rata basis.
Right of First Offer	The right to lease additional space. Landlord must offer space to right holder before landlord can *offer* to lease space to a third party. Terms include identification of space, trigger conditions and exercise timeframe.
Right of First Refusal	The right to lease additional space. Landlord must offer space to right holder before the landlord can *accept* an offer to lease space from a third party. Terms include identification of space, trigger conditions and exercise timeframe.

Finally, to supplement the lease data described above, information about building characteristics and market conditions was obtained. The building and market data includes the following information:

Table 3: Building and Market Data

Variable	Description
Building Square Feet	Total building square feet.
Building Number of Floors	Total number of floors above grade in building.
Year Built	Year construction of building was completed. If a range of years was given, then the midpoint year was used.
CBD/Sub.	Central business district or suburban location.
Building Class	Measure of building quality. All buildings are classified as either A or B.
Market Vacancy	By CBD/sub., class, MSA, and year.

The data set is subject to several potential biases. First, the data was gathered within a limited time period. The generally accepted length of the commercial real estate cycle is ten years, but the data covers only five years. All of these years may have experienced the same market trends, and thus the results of this study may not reflect conditions in other parts of the market cycle. As presented below, however, each of the observations is associated with a market vacancy that ranges from less than 3% to more than 27%. The wide range of market vacancy should represent a variety of market conditions.

Second, the working data set includes only new lease negotiations, which may present a unique set of issues different than other lease negotiations, such as renewals. Furthermore, the focus on new leases as individual transactions may ignore the effect of concurrent negotiations. For example, a national tenant may pay a discounted rent in Boston because it is paying a premium rent in Chicago. Alternatively, a tenant might pay a rent premium in a new lease as a condition of the early termination of another lease.

Third, although the data set is very comprehensive, some potentially important determinants of office rents may be omitted. For example, information about the tenant, including credit rating and industry class, may be determinative. Also, additional location variables such as submarket, employment within one mile, and distance from CBD center may have a significant impact on rents. Finally, more qualitative factors about the building or the leased space, such as design factors or retail amenities, may be important. Although some of this information was available, the data was incomplete and therefore was not used.

Review of Data

This section describes the methods used to analyze the data prior to constructing the hedonic model. Stata statistical software was used to conduct the data analysis and the regression runs.

There are over 26,000 observations in the complete data set. The leases are classified into a variety of use types, including office, retail, storage, and other uses ancillary to office properties. In addition, some observations are classified under special categories such as “shared office” and “government office”. These categories represent office leases under special arrangements or with special tenant types.

The following table presents a tabulation of the entire data set by lease type. Over 90% of the observations are classified as office leases.

Table 4: Lease Type Tabulation (All Leases)

Lease Type	Freq.	Percent	Cum.
Amenity	11	0.04	0.04
Antenna	14	0.05	0.09
Drop Box	1	0.00	0.10
Shared Ofc.	554	2.08	2.18
Gov't Ofc.	12	0.05	2.23
Hotel	1	0.00	2.23
Industrial	140	0.53	2.76
Kiosk	3	0.01	2.77
Office	24,260	91.21	93.98
Parking	1	0.00	93.98
Retail	1,376	5.17	99.16
Sublease	1	0.00	99.16
Storage	160	0.60	99.76
Telecom.	63	0.24	100.00
Total	26,597	100.00	

Prior to any data analysis, all non-office lease observations (including "shared office" and "government office" lease observations) were eliminated from the data set. There are a total of 24,260 office lease observations.

Each office lease observation is classified according to activity type, which indicates the type of negotiation (new lease, renewal, termination, etc.). Based on a review of activity type, 128 lease observations were dropped, including temporary lease activity, storage arrangements, and lease activity denoted as "sold". Presumably, sold activity denotes lease activity (new lease, renewal, termination, etc.) in a sold building that was nonetheless processed by the landlord after the sale.

A further review of activity type reveals that, in some cases, one lease negotiation is counted as two separate activity types. For example, a renewal of an existing lease and a concurrent expansion of the leased space may be recorded once as a renewal and again as an expansion. The bifurcated recording system may help the landlord track changes in leased square feet. For purposes of this paper, however, concurrent renewals and expansions/contractions are presented as one observation. 1,953 observations were dropped when concurrent negotiations were condensed into a single observation.

As a result of the subtractions described above, the total number of office lease observations was reduced to 22,179. The following table shows a tabulation of office lease observations by activity type. New leases, renewals, and terminations are the most common activity types, together encompassing over 75% of the observations.

Table 5: Activity Type Tabulation (All Office Leases)

Activity Type	Freq.	Percent	Cum.
Amendment	221	1.00	1.00
Expansion	2,216	9.99	10.99
New Lease	6,368	28.71	39.70
Renewal	4,469	20.15	59.85
Reduction	915	4.13	63.97
Renewal(Exp)	1,266	5.71	69.68
Renewal(Red)	667	3.01	72.69
Termination	6,057	27.31	100.00
Total	22,179	100.00	

The number of lease terminations during the period may be artificially inflated because renewals, expansions and reductions are in some cases considered to be "new" leases that "terminate" old leases. Obviously, these situations are not true lease terminations. A full analysis of "true" versus "false" terminations was not preformed because this paper does not study lease termination negotiations.

The working data set used in this paper includes only new office lease negotiations. There are a total of 6,368 new office lease observations. Some of these observations were dropped to create a more uniform data set. In addition, some of these observations were eliminated as a result of missing data or typographical errors. Ultimately, the working data set was reduced to a total of 4,494 observations. The following sections describe which observations were dropped and why. The analysis and discussion in the remainder of this paper are limited to the working data set.

Basic Lease Terms

In general, each new lease observation in the data set includes two dates that are relevant to the current negotiation: the date that the lease documentation was received by the landlord and the commencement date of the lease. Usually, the date received precedes the commencement date. Sometimes, however, the date received follows the commencement date. This situation, which occurs in less than 15% of the observations, may arise if the lease documentation is not completed before the commencement date or, alternatively, the documentation is completed but is not forwarded to the lease processing department before the commencement date.

The lag time from date received to commencement date is between -30 and +360 in over 95% of the observations in the working data set. Lag time is positive when date received precedes commencement date, and lag time is negative in the reverse situation. In this paper, the earlier of the year received and the commencement year is used as a proxy for the lease negotiation year. (Year received and commencement year are the same 85% of the time.)

48 observations with lease negotiation years that were missing or outside of the range 2001-2005 were dropped. The following table presents a tabulation of the working data set by lease negotiation year.

Table 6: Lease Negotiation Year Tabulation

Negotiation Year	Freq.	Percent	Cum.
2001	278	6.19	6.19
2002	939	20.89	27.08
2003	1,101	24.50	51.58
2004	1,092	24.30	75.88
2005	1,084	24.12	100.00
Total	4,494	100.00	

Average annual rent values in the working data set have a mean of $25.82 per square foot with a standard deviation of $8.30. The average rent calculation includes the effect of free rent concessions and specified future rent increases/decreases, as well as an estimate of operating expenses and taxes. The data set includes a small number of leases with future rent changes indexed to the CPI. 24 CPI leases were identified and deleted.

In addition, 87 observations with missing average rent or zero average rent were dropped, because this result does not appear to make economic sense. These values may have been typographical errors, or these leases may have been negotiated together with other leases, as part of a larger, multi-lease transaction.

Table 7: Annualized Average Rent (Dollars per Square Foot)

Percentiles	Smallest		
1% 12.24	2.47		
5% 16.37	3.09		
10% 18	5.31	Obs	4494
25% 20.98	5.54	Sum of Wgt.	4494
50% 24.03		Mean	25.81632
	Largest	Std. Dev.	8.298522
75% 28.8	87.84		
90% 36	90.24	Variance	68.86547
95% 40.13	96.35	Skewness	2.10344
99% 57.12	104.1	Kurtosis	12.099

Lease terms in the working data set have a mean of approximately 53 months and a standard deviation of 27 months. The median value is 60 months (5 years). 514 observations with lease terms of less than 12 months were dropped. These short term leases are believed to have different characteristics than a typical office lease. Often, they are month to month leases. Sometimes, a short term lease is a temporary solution that gives the parties time to negotiate a more permanent lease arrangement.

Table 8: Lease Term in Months

Percentiles	Smallest		
1%	12	12	
5%	12	12	
10%	24	12	Obs 4494
25%	36	12	Sum of Wgt. 4494
50%	60		Mean 52.72486
		Largest	Std. Dev. 27.3438
75%	62	191	
90%	84	192	Variance 747.6835
95%	120	192	Skewness 1.02503
99%	126	192	Kurtosis 4.646337

The size of leased space in the working data set has a mean of approximately 5,900 square feet with a standard deviation of 10,200 square feet. Notably, the median value of 3,000 square feet is significantly lower then the mean. 28 observations with leased space of less than 250 square feet were dropped. Again, these small space leases are thought to have different attributes than a typical office lease, due to the type of space and/or the type of tenant who might rent such space.

Table 9: Lease Square Feet

Percentiles	Smallest		
1%	449	267	
5%	840	280	
10%	1091	288	Obs 4494
25%	1797	291	Sum of Wgt. 4494
50%	3023.5		Mean 5934.824
		Largest	Std. Dev. 10262.73
75%	5884	148866	
90%	12921	166487	Variance 1.05e+08
95%	20653	170564	Skewness 7.638873
99%	47158	201800	Kurtosis 96.21814

The lease observations in the working data set are categorized into three basic expense types: net, base year, and gross. Approximately 20% of the leases are net, meaning that the tenant pays all expenses. Two thirds of the leases are base year (or expense stop) leases, which require the landlord to pay a base amount of expenses, and the tenant pays any expenses in excess of the base amount. The remaining leases are assumed to be gross, meaning that the landlord pays all expenses. As noted above, the average rent term includes an estimate of operating expenses and taxes per square foot.

Table 10: Expense Type Tabulation

Expense Type	Freq.	Percent	Cum.
BASE YEAR	3,042	67.69	67.69
GROSS	437	9.72	77.41
NET	1,015	22.59	100.00
Total	4,494	100.00	

Although 53 base year leases are denoted as “net electric”, in general it is not apparent from the data set whether covered expenses include taxes and insurance in addition to common operating expenses such as water, electricity, repairs and maintenance.

Concessions, Allowances and Commissions

Free rent is a commonly negotiated lease concession that allows the tenant to reduce the amount of rent to be paid but at the same time permits the landlord to report a higher amount of nominal rent. In the working data set, about 44% of the lease negotiations include free rent concessions. Free rent is often expressed in terms of months, but the data set presents free rent in terms of dollars per square foot per year (the same units as average rent).

Table 11: Annualized Free Rent (Dollars per Square Foot)

Percentiles		Smallest		
1%	.1	.02		
5%	.26	.02		
10%	.37	.03	Obs	1973
25%	.6	.03	Sum of Wgt.	1973
50%	.95		Mean	1.134234
		Largest	Std. Dev.	.8626427
75%	1.42	7.52		
90%	2.05	8.57	Variance	.7441525
95%	2.64	9.24	Skewness	3.035685
99%	4.44	10.38	Kurtosis	21.22352

To provide additional understanding of the free rent term, the following table presents free rent in months, which is equal to annualized free rent per square foot multiplied by lease term in years divided by average rent per month. Measured this way, free rent has a mean of 2.9 months and a standard deviation of 2.6 months.

Table 12: Free Rent in Months

Percentiles		Smallest		
1%	.1572052	.0441315		
5%	.540242	.0533333		
10%	.9484193	.0648649	Obs	1973
25%	1.009641	.0712589	Sum of Wgt.	1973
50%	2.056402		Mean	2.91115
		Largest	Std. Dev.	2.646917
75%	3.661017	21.22242		
90%	5.996666	23.54825	Variance	7.006167
95%	7.65007	29.9811	Skewness	3.305674
99%	12.56119	32.94331	Kurtosis	23.82842

Tenant improvement allowances (TIs) are another common landlord concession in office leases. In theory, tenant improvement allowances are a method to finance the build-out of the leased space. In the working data set, about 82% of the lease negotiations include tenant improvement allowances. As shown in the following table, tenant improvement allowances in the data set have a mean of $17.07 per square foot with a standard deviation of $13.91.

Table 13: Tenant Improvement Allowance per Square Foot

Percentiles		Smallest		
1%	.5	.05		
5%	1.34	.05		
10%	2.5	.05	Obs	3635
25%	6	.07	Sum of Wgt.	3635
50%	14.23		Mean	17.07125
		Largest	Std. Dev.	13.91685
75%	25	93.58		
90%	35.57	99.62	Variance	193.6787
95%	43.69	100.1	Skewness	1.315931
99%	60	103.97	Kurtosis	5.535552

One might speculate that the amount of TIs will increase with longer lease terms, which are presumably higher value transactions that give both the landlord and the tenant greater incentives to invest in the leased space. Fisher (2004) provides an interesting study of the relationship between lease length and landlord investment. Furthermore, because TIs are generally amortized over the term of the lease, it is interesting to compare TIs on the basis of dollars per square foot per year. The following table shows that, on an annualized basis, TIs have a mean of $3.61 per square foot with a standard deviation of $2.69.

Table 14: Annualized Tenant Improvement Allowance

Percentiles		Smallest		
1%	.1621622	.01		
5%	.5	.0315789		
10%	.8571429	.0348387	Obs	3635
25%	1.666667	.0483871	Sum of Wgt.	3635
50%	3.035		Mean	3.610066
		Largest	Std. Dev.	2.685996
75%	4.904	19.7		
90%	6.832	23.02703	Variance	7.214576
95%	8.4	23.06	Skewness	1.82271
99%	13.348	28	Kurtosis	9.600488

About 88% of the observations include some amount of leasing commissions. Leasing commissions are tabulated separately for affiliated brokers, unaffiliated brokers, and tenant rep brokers. These three amounts are added to produce a total amount of leasing commissions per square foot of leased space. Four observations were dropped because they included commissions that appeared to be excessive and possibly were the result of data entry errors. Leasing commissions per square foot are presented below.

Table 15: Leasing Commissions per Square Foot

Percentiles		Smallest		
1%	.7	.06		
5%	1.36	.0981		
10%	2	.2	Obs	3970
25%	3.58	.23	Sum of Wgt.	3970
50%	5.74		Mean	6.150937
		Largest	Std. Dev.	3.643546
75%	7.86	26.77		
90%	10.425	27.82	Variance	13.27542
95%	12.5	32.97	Skewness	1.478903
99%	18.84	37.25	Kurtosis	7.937641

As with TIs, it is instructive to examine leasing commissions on an annualized basis. Like TIs, leasing commissions are generally amortized over the lease term. In addition, annualized leasing commissions are easy to compare with average rent per year and annualized TIs. The following table shows that, on an annualized basis, leasing commissions have a mean of $1.40 per square foot with a standard deviation of $0.56.

Table 16: Annualized Leasing Commissions

adj_lc

Percentiles		Smallest		
1%	.345	.0560571		
5%	.57	.06		
10%	.8	.0766667	Obs	3970
25%	1.02	.0766667	Sum of Wgt.	3970
50%	1.35		Mean	1.404754
		Largest	Std. Dev.	.5647274
75%	1.666667	4.75		
90%	2.064787	4.83	Variance	.3189171
95%	2.39	4.8864	Skewness	1.297293
99%	3.3	6	Kurtosis	7.639564

Given the data described above, the total consideration over the term of each lease can be calculated as the average rent per year (which includes the effect of free rent and an estimate of expenses) multiplied by lease term in years less the total amount of any tenant improvement allowances and leasing commissions. In ten cases, the total consideration was a negative amount. As with zero average rent leases, there may be an explanation for this result, but this paper does not attempt to analyze these observations, which were dropped.

Lease Options

Lease options are generally desirable to tenants in order to provide flexibility. For example, renewal options are commonly negotiated, as well as termination options or options to expand or contract the leased space. Landlords may also desire flexibility and may negotiate options to relocate tenants or terminate leases under certain conditions.

The terms of these options are specific to each negotiation and may differ substantially, even within each category. For example, a termination option may or may not require a cancellation

fee, and may be exercisable at any time or only at certain times. Furthermore, the option may be held by the tenant, the landlord, or both parties.

The following table shows the number of leases in the working data set that include each option type.

Table 17: Lease Option Tabulation

Option Type	Freq.	Percent
Renewal	1,967	43.77
Termination	649	14.44
Expansion	114	2.54
Reduction	50	1.11

Rights of first offer (RFOs) and rights of first refusal (RFRs) are also common in office leases. Both offer rights and refusal rights give the tenant the right to lease additional space from the landlord in the future, but a right of first offer is triggered *before* a third-party negotiation and a right of first refusal is triggered *after* a third-party negotiation, as discussed below.

A right of first offer requires the landlord to offer the subject space to the holder of the RFO before offering to lease the space to a third party (*pre*-negotiation). The terms of the offer may or may not be specified in the RFO. If the holder of the RFO does not accept the offer, then the landlord may lease the space to another tenant. But the landlord may not lease the space on terms more favorable to the tenant unless the more favorable terms are first offered to the holder of the RFO.

A right of first refusal is more restrictive from the landlord's point of view. A right of first refusal requires the landlord to offer the subject space to the holder of the RFR before accepting an offer to lease the space from a third party (*post*- negotiation). The holder of the RFR has the right to accept the terms of the lease that the parties have negotiated. As a result, the space will be difficult to lease, because any potential tenant will hesitate to spend time and money negotiating the terms of a lease that might be accepted by the holder of the RFR.

The following table shows the number of leases that include rights of first offer/refusal.

Table 18: Right of First Offer/Refusal Tabulation

Type	Freq.	Percent
Right of First Offer	575	12.79
Right of First Refusal	144	3.20
Offer/Refusal Rights	701	15.60

The table also shows that 701 leases include either or both rights. (Note that 18 observations include both offer rights and refusal rights.) Because these rights are very similar, and may in

fact be prone to misinterpretation as one or the other, this paper treats RFOs and RFRs as the same type of amenity.

All option amenities can be summed within each observation to show how many option types are included in each lease. Leases may include different option types as well as multiple options of the same type. For example, one lease may include a renewal option as well as two or more expansion options that apply to different building suites and are subject to different terms and conditions.

The table below presents the number of option types by lease, but does not count multiple options of the same type.

Table 19: Number of Options per Lease

# of Options	Renew. Opts.	Term. Opts.	Exp. Opts.	Red. Opts.	RFOs/ RFRs	# of Leases	Percent
0	0	0	0	0	0	2,217	49.33
1	1,115	189	9	3	73	1,389	30.91
2	590	254	22	10	368	622	13.84
3	220	170	49	12	218	223	4.96
4	35	29	27	18	35	36	0.80
5	7	7	7	7	7	7	0.16
Total	1,967	649	114	50	701	4,494	100.00

As the table shows, about half of the observations do not include any options. Renewal options are the most common variety, and termination options and offer/refusal rights are generally negotiated as the second or third option in a lease.

Building Characteristics

Building data was obtained and was merged with lease data. The working data set includes 384 different buildings. The following table shows a summary of the number of leases per building. Note that some buildings have very few lease observations during the study period (recall that the working data set includes only new leases and excludes lease renewals).

Table 20: Leases per Building

Percentiles		Smallest		
1%	1	1		
5%	1	1		
10%	1	1	Obs	384
25%	4	1	Sum of Wgt.	384
50%	8.5		Mean	11.5599
		Largest	Std. Dev.	11.06716
75%	16	52		
90%	26	52	Variance	122.482
95%	32	71	Skewness	2.351868
99%	52	93	Kurtosis	12.8652

Each of the building characteristics is discussed below. Unless otherwise indicated, the statistics are across buildings (384 observations) not leases (4,494 observations). Some of the

building statistics are used to generate lease statistics. For example, year built is subtracted from negotiation year to generate age, which is a lease-specific variable.

Building square feet has a mean of approximately 230,000 square feet with a standard deviation of 240,000. Several buildings include over 1 million square feet. Over 80% of the buildings are less than 500,000 square feet.

Table 21: Building Square Feet Summary

	Percentiles	Smallest		
1%	21275	4300		
5%	41808	13588		
10%	50377	14108	Obs	384
25%	87294	21275	Sum of Wgt.	384
50%	150146.5		Mean	229717.4
		Largest	Std. Dev.	241929.7
75%	275021	1329810		
90%	502365	1458808	Variance	5.85e+10
95%	706864	1520288	Skewness	2.798729
99%	1329810	1765694	Kurtosis	13.06223

Lease square feet (discussed above) was divided by building square feet to produce lease proportion, a lease-specific measure of relative lease size. Lease proportion is expressed in percentage terms. Note that most individual leases in the working data set constitute a very small percentage of building size. See Table 9 for a summary of lease size in square feet.

Table 22: Lease Proportion (Lease-Specific)

	Percentiles	Smallest		
1%	.0804044	.0281002		
5%	.216861	.0286679		
10%	.3512008	.0291409	Obs	4494
25%	.7089615	.0330201	Sum of Wgt.	4494
50%	1.477878		Mean	3.214214
		Largest	Std. Dev.	6.025146
75%	3.252409	89.1807		
90%	6.965815	96.59756	Variance	36.30238
95%	11.42893	100	Skewness	7.035457
99%	30.0671	100	Kurtosis	79.847

Information about number of floors in each building was also included in the data set. Number of floors ranges from 1 to 76, with mean of 10 and a median of 6 floors.

Table 23: Building Number of Floors

Percentiles		Smallest		
1%	1	1		
5%	2	1		
10%	2	1	Obs	384
25%	3	1	Sum of Wgt.	384
50%	6		Mean	10.19531
		Largest	Std. Dev.	10.60055
75%	13	48		
90%	24	52	Variance	112.3717
95%	34	54	Skewness	2.226358
99%	48	76	Kurtosis	9.154459

As presented in the following table, year built of each building ranges from 1893 to 2004. 65% of the buildings were built from 1980 to 1989.

Table 24: Year Built

Percentiles		Smallest		
1%	1906	1893		
5%	1967	1898		
10%	1972	1899	Obs	384
25%	1980	1906	Sum of Wgt.	384
50%	1984		Mean	1982.586
		Largest	Std. Dev.	12.64964
75%	1988	2001		
90%	1996	2003	Variance	160.0135
95%	1999	2004	Skewness	-3.43672
99%	2001	2004	Kurtosis	22.77217

Year built was subtracted from lease negotiation year to generate age, which is a lease-specific variable. In this study, ages do not vary much within the same building, but over a longer study period, the same building may be leased at many different ages. The following table is a summary of age. Note that a value of -1 indicates that the building was pre-leased (lease negotiation year precedes year built).

Table 25: Age (Lease-Specific)

Percentiles		Smallest		
1%	2	-1		
5%	9	-1		
10%	13	-1	Obs	4494
25%	16	-1	Sum of Wgt.	4494
50%	19		Mean	21.20316
		Largest	Std. Dev.	12.10663
75%	23	110		
90%	31	111	Variance	146.5706
95%	35	111	Skewness	3.21068
99%	75	112	Kurtosis	17.97127

The following table shows a tabulation of the lease and building observations in the working data set by CBD/suburban classification. Note that the leasing activity is roughly the same proportion of CBD to suburban as the building observations.

Table 26: CBD/Suburban Tabulation

CBD/Sub.	Lease Freq.	Lease Percent	Bldg. Freq.	Bldg. Percent
CBD	1,078	23.99	79	20.57
Suburban	3,416	76.01	305	79.43
Total	4,494	100.00	384	100.00

The following table shows a tabulation of the lease and building observations in the working data set by building class. As with the CBD/suburban classification, the leasing activity is in the same relative proportion as the building observations.

Table 27: Building Class Tabulation

Building Class	Lease Freq.	Lease Percent	Bldg. Freq.	Bldg. Percent
A	3,588	79.84	303	78.91
B	906	20.16	81	21.09
Total	4,494	100.00	384	100.00

When building data was added, 423 lease observations in 83 buildings were dropped because building square feet, number of floors, or location (CBD/suburban) was unavailable. In addition, 675 lease observations in 76 buildings were dropped because there was no information regarding year built. For the most part, these dropped observations appear to be buildings that were sold by the landlord, which may introduce a bias to the data.

Market Conditions

Market conditions include time, quality, and location factors. Time and quality are measured by the negotiation year variable and the building class variable. The location variables in the data set include the CBD/suburban classification, and a discreet variable for market (MSA), discussed below.

There are 16 MSAs included in the working data set. Due to an insufficient number of leases or buildings per MSA (less than 50 leases or 5 buildings), 61 observations and 3 MSAs were dropped. Additional MSAs were previously eliminated due to missing data or other reasons described above.

The following table shows a tabulation of the lease and building observations in the working data set by MSA.

Table 28: MSA Tabulation

MSA	Lease Freq.	Lease Percent	Bldg. Freq.	Bldg. Percent
ATL	187	4.16	24	6.25
BOS	305	6.79	42	10.94
CHG	495	11.01	24	6.25
DC	150	3.34	19	4.95
DEN	199	4.43	13	3.39
EBY	189	4.21	11	2.86
LA	317	7.05	32	8.33
NYC	53	1.18	6	1.56
OC	424	9.43	29	7.55
POR	360	8.01	29	7.55
SAC	233	5.18	25	6.51
SD	99	2.20	10	2.60
SEA	434	9.66	30	7.81
SF	519	11.55	45	11.72
SJ	454	10.10	38	9.90
STM	76	1.69	7	1.82
Total	4,494	100.00	384	100.00

All of the market variables (CBD/suburban, building class, MSA, and negotiation year) are combined to determine the market vacancy rate, which is based on historical market data. The following table presents a brief summary of the current and lagged vacancy rates (1 year lag) that correspond with the observations in the working data set.

Table 29: Market Vacancy

Variable	Obs	Mean	Std. Dev.	Min	Max
Vacancy	4494	16.41734	4.952767	2.6	27.23
Lagged vacancy	4494	16.68632	5.29568	1.08	27.23

Summary of Data

The working data set consists of 4,494 observations. The following table shows the order in which observations were dropped to get to the working data set.

Table 30: Order of Elimination of Observations

Data Set/Lease Observations Eliminated	**# of Observations**
Complete Data Set	**26,597**
Non-Office Leases	(2,337)
Temporary, Storage or Sold Activity Type	(128)
Concurrent Negotiations	(1,953)
Office Leases	**22,179**
Non-New Leases	(15,811)
New Office Leases	**6,368**
Lease Negotiation Year Pre-2001 or Missing	(48)
CPI Leases	(24)
Average Rent Zero or Missing	(87)
Lease Term Less Than 12 Months	(514)
Lease Square Feet Less Than 250	(28)
Excessive Leasing Commissions	(4)
Total Consideration Less Than Zero	(10)
No Building SF, # of Floors, or Location Info	(423)
No Year Built Info	(675)
Less Than 50 Leases or 5 Buildings in MSA	(61)
Working Data Set	**4,494**

Chapter 3: Methodology

The methodology used to generate the hedonic model is simple linear regression. As discussed below, some of the continuous variables are categorized into dummy variables, and some variables are combined to produce interaction terms.

Dependent Variable

The natural log of average rent per square foot per year is used as the dependent variable in this paper. The average rent calculation includes the effect of free rent concessions and future rent increases/decreases, as well as an estimate of operating expenses and taxes. Landlord payments such as tenant improvement allowances and leasing commissions are not subtracted from average rent. Instead, these amounts are used as independent variables on the right-hand side of the regression equation.

Average rent is not discounted and is stated in nominal dollars. In theory, "net effective rent" is a better measure of value than average rent. Although the data set includes a net present value of each lease negotiation, this figure was considered to be unreliable due to the potential variations in assumptions and methods used to calculate each NPV. Therefore, average rent was used as the next best alternative. Wheaton and Torto (1994) also use an alternative to net effective rent as the dependent variable.

Dummy Variables

Dummy variables were generated for the categorical variables of expense type, CBD/suburban, building class, MSA, and year. The omitted values were net lease, suburban, class B, Chicago, and 2005.

Additional dummy variables were generated for some of the continuous variables. TIs and leasing commissions presented a unique problem, because these variables were equal to zero in approximately one fourth of the observations. The non-zero values of these variables ranged up to over $100 per square foot for TIs, and over $35 per square foot for leasing commissions. The annualized values of these variables provided a tighter range of values, which were categorized into three dummy variables with the divisions loosely based on the 20th and 80th percentiles. The base case (omitted dummy) is a lease with no TIs or leasing commissions.

The following tables show the distribution of observations among the dummy variables for annualized TIs and leasing commissions (LCs) per square foot.

Table 31: TI Dummy Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
TI=$0	859	0	0	0	0
$0<TI<=$1	538	.6335188	.3005297	.01	1
$1<TI<=$5	2272	2.93755	1.108843	1.010323	5
$5<TI	825	7.403206	2.633062	5.002	28

Table 32: LC Dummy Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
LC=$0	524	0	0	0	0
$0<LC<=$1	932	.7813075	.2223954	.0560571	1
$1<LC<=$2	2584	1.437286	.2587117	1.000449	2
$2<LC	454	2.499449	.5515511	2.00069	6

Dummy variables were also created for building age categories. The categories are based on age groups that are assumed to share similar attributes: less than or equal to 2, 3-15, 16-30, and more than 30 years old. The base case (omitted dummy) is a lease in a building over 30 years old. Recall that age is a lease-specific variable and that a value of -1 indicates pre-leasing activity.

Table 33: Age Dummy Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Age<=2	56	.375	1.121079	-1	2
2<Age<=15	1020	12.17549	3.427303	3	15
15<Age<=30	2941	20.59708	3.65053	16	30
Age>30	477	46.68973	19.92518	31	112

Finally, dummy variables were generated based on options data. A dummy variable representing each option type was assigned a value of 1 whenever that option type was included in the lease. Rights of first offer/refusal were combined into one option category. The base case (omitted dummy) is a lease with no options or lease rights. See Table 17 and Table 18 for tabulations of options and lease rights.

Interaction Terms

In addition to the dummy variables, some interaction terms were generated between variables. Namely, the negotiation year dummy variables were interacted with lease term in months as well as the options dummy variables.

The lease term interactions are equal to the negotiation year dummy variables multiplied by the lease term in months. Each observation includes five lease term interaction values (five possible negotiation years), four of which are equal to zero. The fifth interaction term is equal to the lease term in months. These interactions will allow the term structure of rents to vary over time.

The options interaction terms are equal to the negotiation year dummy variables multiplied by the options dummy variables. Each observation includes 25 option interaction values (five option types in each of the five possible negotiation years). Twenty of the interaction terms are equal to zero (five option types in each of the four years which are not equal to the negotiation year). The other five interactions are either zero or one, depending on whether the option types are included in the lease. It is possible that all of the option interactions are zero, if the lease

does not include any options. Like the lease term interactions, the option interaction will allow the effect of lease options to vary over time.

Linear Regression

The following table shows all of the regression variables (excluding the interaction terms), grouped into lease, building, and market-specific categories.

Table 34: Regression Variables

Lease-Specific	Building-Specific	Market-Specific
Average Rent Over Term	Building Square Feet	MSA (dummy var.)
Lease Term in Months	Building Number of Floors	Year (dummy var.)
Lease Square Feet	CBD/suburban (dummy var.)	Vacancy (by CBD/ sub., class, MSA, and year)
Lease Proportion	Building Class (dummy var.)	
Building Age (dummy var.)		
Expense Type (dummy var.)		
TI Allowance Over Term (dummy var.)		
Leasing Commissions Over Term (dummy var.)		
Option Data (dummy var.)		

The appendix to this paper includes a covariance matrix with all of the regression variables.

The regression equation used in this paper is a log-linear form, based on prior studies and the conclusions of Brennan et al. (1984). In this form, the dependent variable is the natural log of average rent per square foot per year. As a result, each variable will have a constant percentage impact on average rent. This impact is approximately equal to the regression coefficient multiplied by the change in units of the regression variable. For example, a coefficient of .002 for lease square feet means that an increase of 10,000 square feet will increase rent by approximately .002 * 10,000 = 20%. Because dummy variables can only assume values of 0 or 1, the coefficients themselves represent the percentage impact of these variables.

Through the process of experimentation with the variables and different regression equations, certain variables were added or dropped. Term in months squared was added. This variable is designed to show whether the effect of a unit change in lease term in months is increasing or decreasing with each additional month (concave or convex).

Both building square feet and building number of floors were dropped. The combination of lease square feet, lease proportion, and the CBD dummy variable was determined to be a better combination of variables without building square feet and building number of floors.

In addition, the options data with respect to space expansion and reduction options (and the related interaction terms) were dropped because there were not enough observations in the working data set.

Finally, lagged vacancy (1 year lag) was used instead of current vacancy. Many studies have concluded that lagged vacancy is a better indicator of current rent, including Wheaton and Torto (1994).

Here is the form of the regression equation (excluding the interaction terms):

$$\log(R) = \alpha_0 + \alpha_1 TERM + \alpha_2 TERM^2 + \alpha_3 SQFT + \alpha_4 PROP + \alpha_5 CBD + \alpha_6 CLASS + \alpha_7 VAC + \sum_{i=1}^{3} \beta_i AGE_i + \sum_{j=1}^{15} \delta_j MSA_j + \sum_{k=1}^{4} \lambda_k YEAR_k + \sum_{l=1}^{2} \mu_l EXP_l + \sum_{m=1}^{3} \rho_m TI_m + \sum_{n=1}^{3} \tau_n LC_n + \alpha_8 RENEW + \alpha_9 TRMNT + \alpha_{10} ROF$$

where:

R	Average rent per square foot per year.
TERM	Lease term in months.
SQFT	Lease square feet.
PROP	Lease proportion.
CBD	(=1 if CBD, =0 if suburban)
CLASS	(=1 if class A, =0 if class B)
VAC	Lagged vacancy (1 year lag).
AGE	Dummy variable for each age group (<=2, 3-15, 16-30).
MSA	Dummy variable for each MSA (except CHG).
YEAR	Dummy variable for each year (except 2005).
EXP	Dummy variable for each expense type (except NET).
TI	Dummy variable for each TI/sf/yr group (<$1, $1-5, >$5)
LC	Dummy variable for each LC/sf/yr group (<$1, $1-2, >$2)
RENEW	(=1 if option to renew, =0 otherwise)
TRMNT	(=1 if option to terminate, = 0 otherwise)
ROF	(=1 if right of first offer/refusal, =0 otherwise)
α, β, δ, λ, ,μ ρ, τ	Estimated statistical parameters.

Chapter 4: Results

This section presents the results of three regression runs: the base case and two models including the interaction terms described above.

Model #1

The base case regression excludes the interaction terms. Table 35 presents the base case results. Dummy variables are indicated by "D_".

The adjusted R-squared value of the base case model is 55%. Various experimental iterations, which added, subtracted, and combined different variables, consistently produced models with R-squared values between 50-60%. This range is consistent with the prior literature. See Dunse and Jones (1998).

The positive coefficient for lease term in months indicates that there is a rent premium for longer leases. The negative coefficient for term squared, on the other hand, shows that the additional premium per month decreases with each additional month. The result is that, on average across all markets, there is an upward-sloping, convex term structure of rent. Based on the model, an additional 12 months of lease term will increase rent by approximately 2.4%. Model #2, discussed below, will use the lease term interactions to analyze term structure within different lease negotiation years.

The positive coefficient for lease square feet shows that there is a rent premium for larger leases. However, the effect is not statistically significant and the very small magnitude of the coefficient indicates that the "size premium" is very small. Lease proportion, which measures size as a percentage of building square feet, has a greater impact on rent levels. The coefficient for lease proportion is negative, meaning that there is a rent discount for leases that occupy a larger proportion of the building space. Lease proportion is expressed in percentage terms. Therefore, an additional 10% of lease proportion (i.e., an additional 10,000 square feet in a 100,000 square foot building) will decrease rent by 4.7%.

The coefficient for the CBD dummy variable indicates that there is a 3.8% premium applicable to CBD office leases, as opposed to suburban.

The class A dummy variable has a large impact on rent levels. Based on the model, class A office leases will command a 16.7% premium over class B.

Only one building age group is statistically significant. The model indicates that there is an 11.8% premium for a new building (less than or equal to 2 years old), as opposed to a building more than 30 years old (the omitted age group). The model does not show a significant difference among the other building age groups.

All but two of the MSA dummy variables have a significant impact on rent. Furthermore, the coefficients generally have the expected signs and magnitudes. At the low and high ends of the spectrum, New York rents include a 50% premium over Chicago (the omitted MSA), and Denver rents include a 31.9% discount.

All of the lease negotiation years are statistically significant. The model shows that 2001 was the best year within the study period. The model also shows that 2005 (the omitted year) was an improvement over the prior years. Both of these results are consistent with the general state of

the overall office market, which weakened in the early 2000's, after the tech bust and 9/11, and strengthened in 2005.

The model uses lagged vacancy, in addition to MSA and year dummies, to approximate market conditions. Lagged vacancy has the advantage of being a continuous variable. Based on the regression results, a 5% decrease in vacancy rate will increase rent by 6.5%. Recall that vacancy is by CBD/suburban and building class as well as by MSA and year. The coefficients of these dummy variables represent any variation among categories that is not reflected in the vacancy statistic.

The coefficients for the expense type dummy variables may be misleading. Other studies have concluded that net rents, where the tenant pays all expenses, will be lower than gross or base year (expense stop) rents, where the landlord pays all or a portion of the expenses. See Wheaton and Torto (1994); Glasscock et al. (1990). In this study, the dependent variable includes an estimate of operating expenses and taxes. Therefore, as adjusted, net rents should be the same as gross rents and base year rents. The regression model, however, predicts that base year leases will generate a 4.1% discount below net leases (the omitted expense type), and gross leases will result in a 7.6% discount.

With the possible exception of the expense type dummy variables, the basic lease, building and market parameters discussed above appear to work well in the base case model. The next variables to consider are the contractual terms, including allowances, commissions, and lease options.

Tenant improvement allowances and leasing commissions appear to follow a similar pattern. Low levels of TIs and LCs do not appear to have a significant impact on rent. At higher levels, however, the presence of TIs and LCs has a significant positive impact on rent. Recall that both TIs and LCs are expressed on an annualized basis in dollars per square foot per year. The model predicts that leases with TIs above $5/sf/yr will produce a rent premium of 4.9%, in comparison to a lease with no tenant improvement allowance. The predicted effect of leasing commissions is even greater. Above a threshold of $2/sf/yr, the presence of LCs will increase rent by 15.9% over a lease with no leasing commissions.

A review of the option dummy variables reveals that renewal options do not appear to consistently affect rent levels, but that both termination options and rights of offer/refusal appear to generate rent discounts. Termination options are associated with a 3.7% discount from leases with no options, and rights of first offer/refusal generate a 2.6% discount. Models #2 and 3 analyze the impact of lease options within different lease negotiation years.

Model #2

Model #2 includes the interactions between negotiation year, lease term and options. Lease term in months, term squared, and the dummy variables for negotiation year and lease options are excluded. With the exclusion of the year dummy variable, lagged vacancy and the interaction terms will represent market conditions in each year.

Table 36 presents the results of model #2. Interaction terms are indicated by "I_". The adjusted R-squared value is essentially unchanged from the base case. And the coefficients for the non-interaction variables are also consistent with the base case.

The lease term interactions show that there is a consistent upward-sloping term structure in every year. This demonstrates the robustness of model #1, which produces the average term structure across all years. Based on the results of model #2, model #1 appears to be an accurate representation of the term structure. Therefore, the lease term interactions are unnecessary and are eliminated in model #3.

The option interaction variables are not consistent across all years. In most years, the impact of all three options is insignificant, but in 2002 rights of first offer/refusal have a negative effect on rent levels, and in 2005 renewal options have a positive effect while termination options have a negative effect. Model #3 further examines these results.

Model #3

Model #3 includes the option interaction terms but not the lease term interactions. As with the base case, lease term in months and term squared are included. As with model #2, the dummy variables for lease negotiation year and lease options are excluded.

Table 37 presents the results of model #3. Again, the adjusted R-squared value is unchanged from the base case. Note that the lagged vacancy has a greater impact in this model. This change may be due to the omission of interaction terms with respect to leases that do not include any options, which forces lagged vacancy to completely represent market conditions in each year.

The option interaction terms in this model are similar to the previous regression. Interestingly, renewal options are associated with rent discounts in 2003 and rent premiums in 2005. Termination options appear to have consistently negative impacts, with significant values in 2004 and 2005. Rights of first offer/refusal also tend to have negative impacts, especially in 2002 and 2004.

Table 35: Model #1 (Base Case)

Source	SS	df	MS		Number of obs =	4494
Model	210.215226	40	5.25538065		F(40, 4453) =	137.40
Residual	170.325241	4453	.038249549		Prob > F =	0.0000
Total	380.540467	4493	.084696298		R-squared =	0.5524
					Adj R-squared =	0.5484
					Root MSE =	.19557

log_rent	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
term_in_mos	.0020705	.0003845	5.38	0.000	.0013166	.0028244
term_sqrd	-4.45e-06	2.75e-06	-1.62	0.105	-9.84e-06	9.38e-07
lease_sqft	7.07e-07	4.30e-07	1.64	0.101	-1.37e-07	1.55e-06
lease_prop	-.0047011	.0006611	-7.11	0.000	-.0059973	-.003405
D_cbd	.0380627	.0108036	3.52	0.000	.0168822	.0592431
D_class_A	.1670899	.0083736	19.95	0.000	.1506736	.1835062
D_age<=2	.1176023	.0294103	4.00	0.000	.0599435	.175261
D_age_3-15	.0075326	.0124821	0.60	0.546	-.0169386	.0320038
D_age_16-30	.0090369	.0108725	0.83	0.406	-.0122787	.0303524
D_msa_ATL	-.2340063	.018412	-12.71	0.000	-.270103	-.1979097
D_msa_BOS	.136265	.0159895	8.52	0.000	.1049176	.1676124
D_msa_DC	.1459287	.0207454	7.03	0.000	.1052574	.1865999
D_msa_DEN	-.3186192	.0169631	-18.78	0.000	-.3518753	-.2853632
D_msa_EBY	-.0700348	.0192869	-3.63	0.000	-.1078466	-.032223
D_msa_LA	.1324162	.0160916	8.23	0.000	.1008686	.1639638
D_msa_NYC	.4198585	.0312241	13.45	0.000	.3586438	.4810732
D_msa_OC	-.0151306	.0165854	-0.91	0.362	-.0476461	.017385
D_msa_POR	-.206542	.0156834	-13.17	0.000	-.2372892	-.1757947
D_msa_SAC	.0267556	.0184158	1.45	0.146	-.0093485	.0628598
D_msa_SD	.1872266	.0236757	7.91	0.000	.1408105	.2336428
D_msa_SEA	-.1291022	.014491	-8.91	0.000	-.1575118	-.1006927
D_msa_SF	.1393787	.0145535	9.58	0.000	.1108466	.1679107
D_msa_SJ	-.0486484	.0146296	-3.33	0.001	-.0773297	-.0199672
D_msa_STM	.1601474	.0263255	6.08	0.000	.1085363	.2117584
D_year_2001	.0867917	.0156724	5.54	0.000	.0560659	.1175174
D_year_2002	.0294239	.0094637	3.11	0.002	.0108703	.0479775
D_year_2003	-.0311553	.0094019	-3.31	0.001	-.0495877	-.0127229
D_year_2004	-.0288635	.0091898	-3.14	0.002	-.04688	-.010847
lag_vacancy	-.0130558	.0010373	-12.59	0.000	-.0150895	-.0110222
D_exp_BS_YR	-.0410976	.0093904	-4.38	0.000	-.0595074	-.0226878
D_exp_GROSS	-.0764983	.0128558	-5.95	0.000	-.101702	-.0512946
D_ti_0-1	.0165592	.0113391	1.46	0.144	-.0056712	.0387895
D_ti_1-5	.0177483	.0091511	1.94	0.053	-.0001923	.035689
D_ti>5	.0488848	.0108402	4.51	0.000	.0276327	.0701369
D_lc_0-1	-.0215714	.0116401	-1.85	0.064	-.0443918	.0012491
D_lc_1-2	.0131398	.0106797	1.23	0.219	-.0077977	.0340773
D_lc>2	.1592023	.0141078	11.28	0.000	.131544	.1868607
D_opt_renew	.0074022	.0069661	1.06	0.288	-.0062548	.0210592
D_opt_trmnt	-.0370504	.0088704	-4.18	0.000	-.0544407	-.0196601
D_opt_rof	-.0258659	.009323	-2.77	0.006	-.0441435	-.0075882
_cons	3.205863	.0286071	112.07	0.000	3.149779	3.261947

Table 36: Model #2 (Lease Term and Option Interactions)

Source	SS	df	MS	Number of obs =	4494
Model	210.403526	51	4.12555933	F(51, 4442) =	107.71
Residual	170.136941	4442	.038301878	Prob > F =	0.0000
Total	380.540467	4493	.084696298	R-squared =	0.5529
				Adj R-squared =	0.5478
				Root MSE =	.19571

log_rent	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lease_sqft	5.97e-07	4.14e-07	1.44	0.150	-2.15e-07	1.41e-06
lease_prop	-.0046823	.0006585	-7.11	0.000	-.0059733	-.0033913
D_cbd	.0305811	.0106017	2.88	0.004	.0097966	.0513657
D_class_A	.1698229	.0083476	20.34	0.000	.1534574	.1861883
D_age_2	.128435	.0295417	4.35	0.000	.0705187	.1863514
D_age_3_15	.0121893	.0124701	0.98	0.328	-.0122583	.0366369
D_age_16_30	.0110965	.0108888	1.02	0.308	-.010251	.0324439
D_msa_ATL	-.2358056	.0184717	-12.77	0.000	-.2720192	-.1995919
D_msa_BOS	.1302783	.0159638	8.16	0.000	.0989813	.1615754
D_msa_DC	.1374696	.0206366	6.66	0.000	.0970115	.1779277
D_msa_DEN	-.3145439	.0169566	-18.55	0.000	-.3477873	-.2813005
D_msa_EBY	-.0769147	.019254	-3.99	0.000	-.1146621	-.0391673
D_msa_LA	.125036	.0160735	7.78	0.000	.0935238	.1565481
D_msa_NYC	.4077524	.0311229	13.10	0.000	.3467361	.4687688
D_msa_OC	-.0233208	.016437	-1.42	0.156	-.0555456	.0089039
D_msa_POR	-.2078786	.0156536	-13.28	0.000	-.2385674	-.1771898
D_msa_SAC	.0166466	.0184208	0.90	0.366	-.0194673	.0527605
D_msa_SD	.1777115	.0236379	7.52	0.000	.1313695	.2240535
D_msa_SEA	-.1350225	.0144084	-9.37	0.000	-.1632701	-.1067748
D_msa_SF	.142026	.0145218	9.78	0.000	.1135559	.170496
D_msa_SJ	-.0551025	.0145955	-3.78	0.000	-.0837169	-.026488
D_msa_STM	.1522997	.0263615	5.78	0.000	.100618	.2039815
lag_vacancy	-.014352	.0009598	-14.95	0.000	-.0162337	-.0124703
D_exp_BS_YR	-.0427392	.0093534	-4.57	0.000	-.0610765	-.0244018
D_exp_GROSS	-.0787225	.0128025	-6.15	0.000	-.1038218	-.0536232
D_ti_0_1	.016732	.0113111	1.48	0.139	-.0054433	.0389074
D_ti_1_5	.0195299	.0089945	2.17	0.030	.0018961	.0371636
D_ti_5	.0511583	.0106047	4.82	0.000	.0303677	.0719489
D_lc_0_1	-.0180718	.0115366	-1.57	0.117	-.0406893	.0045456
D_lc_1_2	.0170894	.0105019	1.63	0.104	-.0034997	.0376784
D_lc_2	.1643346	.013935	11.79	0.000	.1370151	.191654
I_term_01	.0028568	.0003148	9.08	0.000	.0022397	.003474
I_term_02	.0021738	.0002033	10.69	0.000	.0017753	.0025723
I_term_03	.0011185	.0001987	5.63	0.000	.000729	.0015081
I_term_04	.001124	.0001966	5.72	0.000	.0007386	.0015093
I_term_05	.0013838	.0001969	7.03	0.000	.0009978	.0017698
I_opt_rnw_01	-.0205743	.0302615	-0.68	0.497	-.0799019	.0387533
I_opt_rnw_02	-.0017345	.0155979	-0.11	0.911	-.0323142	.0288452
I_opt_rnw_03	-.0170177	.013715	-1.24	0.215	-.0439059	.0098705
I_opt_rnw_04	.0087634	.0128735	0.68	0.496	-.0164751	.034002
I_opt_rnw_05	.0391225	.0129549	3.02	0.003	.0137244	.0645206
I_opt_trm_01	-.0519247	.0460795	-1.13	0.260	-.1422634	.038414
I_opt_trm_02	-.0356426	.021004	-1.70	0.090	-.076821	.0055357
I_opt_trm_03	-.0127666	.0167633	-0.76	0.446	-.0456311	.0200979
I_opt_trm_04	-.0266316	.016625	-1.60	0.109	-.0592248	.0059617
I_opt_trm_05	-.0712944	.0182369	-3.91	0.000	-.1070477	-.035541
I_opt_rof_01	.0003653	.0391227	0.01	0.993	-.0763348	.0770653
I_opt_rof_02	-.0591464	.0210942	-2.80	0.005	-.1005016	-.0177913
I_opt_rof_03	-.0080626	.0180662	-0.45	0.655	-.0434814	.0273561
I_opt_rof_04	-.0260556	.0180511	-1.44	0.149	-.0614447	.0093335
I_opt_rof_05	-.0214721	.0179449	-1.20	0.232	-.056653	.0137088
_cons	3.236143	.0267951	120.77	0.000	3.183611	3.288675

Table 37: Model #3 (Option Interactions)

Source	SS	df	MS		Number of obs	=	4494
Model	208.779203	48	4.34956673		F(48, 4445)	=	112.56
Residual	171.761263	4445	.038641454		Prob > F	=	0.0000
Total	380.540467	4493	.084696298		R-squared	=	0.5486
					Adj R-squared	=	0.5438
					Root MSE	=	.19657

log_rent	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
term_in_mos	.0021912	.000387	5.66	0.000	.0014325	.0029499
term_sqrd	-5.25e-06	2.77e-06	-1.90	0.058	-.0000107	1.74e-07
lease_sqft	7.60e-07	4.33e-07	1.75	0.080	-8.98e-08	1.61e-06
lease_prop	-.0047626	.0006653	-7.16	0.000	-.006067	-.0034582
D_cbd	.0143948	.0103489	1.39	0.164	-.0058942	.0346839
D_class_A	.1726103	.0083621	20.64	0.000	.1562163	.1890042
D_age_2	.1277939	.0296226	4.31	0.000	.0697189	.1858689
D_age_3_15	.0164308	.012498	1.31	0.189	-.0080715	.0409331
D_age_16_30	.0075971	.0109287	0.70	0.487	-.0138286	.0290228
D_msa_ATL	-.2295034	.0185235	-12.39	0.000	-.2658187	-.1931881
D_msa_BOS	.1257462	.0160075	7.86	0.000	.0943634	.1571289
D_msa_DC	.1199352	.0205399	5.84	0.000	.0796667	.1602036
D_msa_DEN	-.3097643	.0170108	-18.21	0.000	-.343114	-.2764147
D_msa_EBY	-.0843454	.0192872	-4.37	0.000	-.1221579	-.0465328
D_msa_LA	.1173315	.0160843	7.29	0.000	.0857983	.1488646
D_msa_NYC	.3987896	.0313301	12.73	0.000	.3373671	.4602121
D_msa_OC	-.0363501	.016348	-2.22	0.026	-.0684002	-.0042999
D_msa_POR	-.2132899	.015686	-13.60	0.000	-.2440423	-.1825374
D_msa_SAC	.0069094	.0183984	0.38	0.707	-.0291606	.0429793
D_msa_SD	.1635379	.0236268	6.92	0.000	.1172177	.2098582
D_msa_SEA	-.1460319	.0143604	-10.17	0.000	-.1741856	-.1178783
D_msa_SF	.1518098	.0145094	10.46	0.000	.1233641	.1802555
D_msa_SJ	-.0623007	.0145928	-4.27	0.000	-.0909098	-.0336916
D_msa_STM	.1462447	.0264674	5.53	0.000	.0943554	.198134
lag_vacancy	-.0169129	.0008705	-19.43	0.000	-.0186195	-.0152064
D_exp_BS_YR	-.0493785	.0093291	-5.29	0.000	-.0676682	-.0310888
D_exp_GROSS	-.0846113	.0126984	-6.66	0.000	-.1095066	-.059716
D_ti_0_1	.0186868	.0114063	1.64	0.101	-.0036752	.0410488
D_ti_1_5	.0161185	.0091793	1.76	0.079	-.0018774	.0341144
D_ti_5	.0448703	.0108233	4.15	0.000	.0236512	.0660895
D_lc_0_1	-.0144201	.0115116	-1.25	0.210	-.0369886	.0081484
D_lc_1_2	.020819	.0104984	1.98	0.047	.0002369	.041401
D_lc_2	.1711938	.0138887	12.33	0.000	.1439651	.1984225
I_opt_rnw_01	.0307257	.0275936	1.11	0.266	-.0233716	.0848229
I_opt_rnw_02	.0260382	.0139274	1.87	0.062	-.0012665	.0533428
I_opt_rnw_03	-.0354698	.0120379	-2.95	0.003	-.0590701	-.0118695
I_opt_rnw_04	-.0071323	.011243	-0.63	0.526	-.0291743	.0149096
I_opt_rnw_05	.0296435	.0113389	2.61	0.009	.0074136	.0518733
I_opt_trm_01	-.0078395	.0453187	-0.17	0.863	-.0966867	.0810078
I_opt_trm_02	-.0236566	.0208923	-1.13	0.258	-.0646159	.0173026
I_opt_trm_03	-.0241108	.0163586	-1.47	0.141	-.0561818	.0079601
I_opt_trm_04	-.037223	.0162674	-2.29	0.022	-.0691153	-.0053307
I_opt_trm_05	-.076116	.0179012	-4.25	0.000	-.1112113	-.0410208
I_opt_rof_01	.0192858	.0390779	0.49	0.622	-.0573264	.0958981
I_opt_rof_02	-.0424094	.020857	-2.03	0.042	-.0832995	-.0015193
I_opt_rof_03	-.014206	.0179319	-0.79	0.428	-.0493614	.0209494
I_opt_rof_04	-.0349825	.0177753	-1.97	0.049	-.069831	-.000134
I_opt_rof_05	-.0234544	.017681	-1.33	0.185	-.058118	.0112092
_cons	3.275016	.0265661	123.28	0.000	3.222933	3.327099

Summary of Results

The following is a bullet-point summary of the results discussed above:

- There is a consistent, upward-sloping, convex term structure of rent.
- There is an insignificant "size premium" but the "proportion discount" is significant.
- As expected, CBD and class A leases include rent premiums. The class A premium is very large (16.7%).
- New buildings generate significant rent premiums. Rents in the other age groups were not significantly different than rents in the over 30 age group.
- There is a considerable difference across MSAs. The results show a range of rent premium/discount from +50% to -30% of the omitted MSA (Chicago).
- Each of the lease negotiation years was significantly different from the omitted year (2005).
- The expense type dummy variables are significant, but the results may be misleading. A different specification of the dependent variable, without the adjustment for operating expenses and taxes, might be an improvement.
- TIs and LCs do not have a predictable impact on rent at low levels. But high levels of TIs and LCs result in significant rent premiums.
- Renewal options appear to have positive impacts in some years and negative impacts in other years.
- Termination options and rights of first offer/refusal appear to have negative impacts on rent that are somewhat consistent in all years.

Chapter 5: Conclusions

Final Analysis

The regression model presented in this paper is an interesting start. These results give some answers about the value of contractual terms in office leases, but some questions are left unanswered.

There is a consistent, upward-sloping, convex term structure of rent. This term structure may be the result of increasing rent expectations shared by landlord and tenants. These expectations may be reasonable, given the fact that 2001-2005 is considered to be a relatively weak period in the office leasing market. The negative coefficient for term squared reflects the fact that the parties do not expect rent levels to increase forever. The results of this study with respect to term structure can be compared to Gunnelin and Soderberg (2003), which includes data from a complete boom-and-bust real estate cycle.

There is an insignificant "size premium" but the "proportion discount" is significant. The "proportion discount" may be the result of operating efficiencies that emerge when buildings are leased to a few large tenants as opposed to many small tenants. Notably, in earlier versions of the model, the size premium was significant, but when the lease proportion variable was added, the impact of lease square feet was greatly diminished. These results support the idea that the operating efficiencies, not the absolute size of the leased space, generate the discount.

As expected, CBD and class A leases include rent premiums. The class A premium is very large (16.7%). This result suggests that quality is more important than location. Both the CBD/suburban and class variables can probably be improved. Better controls for quality and location would make a better predictive model, as discussed in the next section.

New buildings generate significant rent premiums. This is consistent with the results of Wheaton and Torto (1994). Rents in the other age groups were not significantly different than rents in the over 30 age group. The most likely explanation of this result is that older buildings with recent renovations and other capital improvements are the same as newer buildings. Unfortunately, the model does not control for renovations and other capital improvements.

There is a considerable difference across MSAs. The results show a range of rent premium/discount from +50% to -30% of the omitted MSA (Chicago). Each of the lease negotiation years was significantly different from the omitted year (2005). Although the lagged vacancy variable has a large impact on rent and is highly significant, the MSA and year variables continue to have significant impacts as well. This result shows that lagged vacancy explains much but not all variation due to market conditions across MSAs and years.

The expense type dummy variables are significant, but the results may be misleading. In this study, the dependent variable includes an estimate of operating expenses and taxes. Therefore, as adjusted, net rents should be the same as gross rents and base year rents. A simple explanation might be that operating expenses and taxes were overestimated for net leases and/or underestimated for gross leases. Alternatively, an analysis of expense types across markets or tenant types might reveal that the different expense types represent external conditions which are responsible for the impact on rents. For example, perhaps net leases are negotiated only in strong markets or only with high-rent tenants. Neither one of these explanations is entirely

satisfying. A different specification of the dependent variable, without the adjustment for operating expenses and taxes, might be an improvement.

TIs and LCs do not have a predictable impact on rent at low levels. But high levels of TIs and LCs result in significant rent premiums. These results appear to make sense. Low levels of TIs and LCs may be expected by the market. Therefore, at lower levels, the small impact on rent may be eclipsed by other factors not present in this model. At higher levels, however, the impact of both terms shines through, as these contractual provisions are clearly priced into rent levels. The impact of high leasing commissions appears to be especially strong. One possible explanation might be that higher leasing commissions are correlated with the involvement of tenant rep brokers, which may indicate an increased amount of size or sophistication on behalf of the transaction or the tenant.

Renewal options appear to have positive impacts in some years and negative impacts in other years. One explanation is that renewal options may not affect rent levels because these options generally specify that the renewal rent is "fair market rent" or "prevailing market rent." Essentially, these options have little to no value, and landlords may be willing to grant renewal options without significant compensation. Alternatively, renewal options may represent amenities that are granted to tenants as inducements in weaker leasing markets but are priced in stronger markets. In fact, the renewal option interaction terms support this theory, with positive coefficients in the relatively strong years of 2001, 2002, and 2005, and negative coefficients in the weaker years of 2003 and 2004.

Termination options and rights of first offer/refusal appear to have negative impacts on rent that are somewhat consistent in all years. Unlike renewal options, termination options and rights of first offer/refusal represent contractual terms that are priced in strong and weak markets. Somewhat surprisingly, however, these option types result in rent discounts. This is counterintuitive because these options are thought to benefit the tenant. One explanation is that these options are in fact beneficial to the landlord. Termination options are sometimes mutual, and often they specify termination fees that may be in excess of what the landlord expects to be able to negotiate ex post without the option. And rights of first offer/refusal might indicate that the tenant is likely to expand and lease additional space from the landlord. Moreover, both types of options represent some amount of pre-negotiation and information exchange that might be valuable to the landlord.

Further study is necessary to understand the value of these options. Overall, more information about options terms would be beneficial. Information such as the renewal rent, the termination fee, and the size of the offer/refusal space would help us to understand the economic arrangement between the parties and to predict the corresponding impact on rent.

Further Study

The regression model presented in this paper could be improved in several different ways. The CBD dummy variable is flawed in that the CBD in Boston may be very different from the CBD in Atlanta. Other location variables such as submarkets, employment within one mile, or distance from CBD center, could improve the model. In many of the prior studies, specific location factors are very important determinants of rent levels. See Ryan (2005); Bollinger et al. (1998); Colwell et al. (1998).

Also, more qualitative factors about the building or the leased space, such as design factors or retail amenities, could be added. These factors are presumably represented by the class variable, which may be too subjective and too dependent on other factors, such as location or age. Furthermore, the class variable is a very rigid measure, with only two possible values (A/B). Additional quality variables with more degrees of freedom could improve the performance of the regression model. Other studies have included such variables with a certain amount of success. See Bollinger et al. (1998); Mills (1992); Brennan et al. (1984).

Likewise, the age variable may be an imperfect solution, as indicated by the lack of any significant difference among non-new age groups. In order to address this problem, a renovation variable could be interacted with the age group dummy variables. This technique was used successfully by Asser (2004). Unfortunately, complete renovation data was not available with respect the working data set used in this paper.

Industry classification of the tenant could be included. This factor could have a large impact on rent. For example, certain industries may be favored by landlords because they are considered to be growth industries, or stable industries. Perhaps more to the point, tenant creditworthiness could be included as well. Including tenant characteristics would perhaps be the most interesting addition to the regression model.

Other techniques, such as conducting multiple regressions by market could reveal trends that are not apparent from the single regression run used in this paper. For example, different contractual terms may be priced differently in each market.

Finally, a study of these variables using a data set that includes a greater number of years could yield results that are more robust. The relatively short five-year time period is a factor that constrains the general applicability of the regression model presented in this paper.

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Appendix: Correlation Matrix

	log_rent	term_i~s	term_s~d	lease_~t	lease_~p	bldg_s~t	bldg_f~s	D_cbd	D_clas~A	D_age_2
log_rent	1.0000									
term_in_mos	0.2006	1.0000								
term_sqrd	0.1973	0.9496	1.0000							
lease_sqft	0.0678	0.4502	0.5124	1.0000						
lease_prop	-0.0735	0.2505	0.2583	0.6221	1.0000					
bldg_sqft	0.1837	0.1714	0.1881	0.1262	-0.2391	1.0000				
bldg_floors	0.2262	0.1591	0.1713	0.0836	-0.2359	0.8740	1.0000			
D_cbd	0.2699	0.1812	0.2033	0.0727	-0.1441	0.5968	0.7115	1.0000		
D_class_A	0.2564	0.1112	0.0897	0.0164	-0.0734	0.0390	0.0336	-0.0437	1.0000	
D_age_2	0.0805	0.0884	0.0768	0.0681	0.0770	-0.0503	-0.0658	0.0168	0.0564	1.0000
D_age_3_15	0.0727	0.0633	0.0497	0.0302	-0.0151	0.0484	-0.0095	-0.0444	0.2259	-0.0609
D_age_16_30	-0.1107	-0.0849	-0.0870	-0.0727	-0.0021	-0.0888	-0.0787	-0.1013	-0.0969	-0.1546
D_msa_ATL	-0.2003	0.0418	0.0433	0.0411	0.0239	-0.0052	-0.0011	-0.0883	0.0380	-0.0134
D_msa_BOS	0.1569	0.0979	0.1070	0.0587	0.0497	-0.0178	-0.0143	0.1923	-0.0077	-0.0303
D_msa_DC	0.1495	0.1164	0.1111	0.0927	0.0346	-0.0438	-0.0423	0.0552	-0.0240	-0.0209
D_msa_DEN	-0.2390	-0.0163	-0.0290	-0.0084	-0.0299	0.0182	0.0629	0.1400	-0.1048	-0.0242
D_msa_EBY	-0.0437	-0.0184	-0.0328	-0.0261	-0.0329	-0.0589	-0.0886	-0.1177	0.1053	-0.0135
D_msa_LA	0.1749	0.0028	0.0044	0.0114	0.0190	0.0244	0.0424	-0.0428	0.0648	-0.0309
D_msa_NYC	0.2772	0.1256	0.1684	0.1199	0.0019	0.0386	0.1405	0.1945	0.0549	-0.0123
D_msa_OC	-0.0276	-0.1138	-0.1067	-0.0398	-0.0341	-0.0805	-0.0975	-0.1813	-0.0351	-0.0363
D_msa_POR	-0.2196	-0.0222	-0.0431	-0.0419	0.0078	-0.1615	-0.1581	-0.0736	0.0768	0.0186
D_msa_SAC	0.0163	-0.0278	-0.0413	-0.0652	0.0092	-0.1489	-0.1614	-0.0844	-0.0451	0.1366
D_msa_SD	0.0981	-0.0445	-0.0426	-0.0191	-0.0035	-0.0700	-0.0479	-0.0843	0.0376	-0.0169
D_msa_SEA	-0.1024	0.0365	0.0314	0.0214	-0.0118	0.1643	0.2095	-0.0108	0.0253	-0.0299
D_msa_SF	0.1469	-0.0167	-0.0190	-0.0087	0.0174	-0.0018	-0.0107	0.0938	0.1208	0.1163
D_msa_SJ	-0.0914	-0.1308	-0.1121	-0.0405	0.0629	-0.1790	-0.1882	-0.1745	-0.1628	-0.0177
D_msa_STM	0.1132	0.0137	0.0061	0.0173	-0.0018	-0.0382	-0.0138	-0.0737	0.0659	-0.0147
D_year_2001	0.1897	0.0024	0.0032	0.0301	-0.0080	0.0999	0.1158	0.1175	-0.0045	0.0294
D_year_2002	0.0624	-0.0208	-0.0286	-0.0054	0.0178	-0.0301	-0.0463	-0.0465	-0.0241	-0.0133
D_year_2003	-0.1048	-0.0044	0.0043	-0.0111	-0.0117	-0.0051	-0.0205	-0.0147	0.0219	0.0759
D_year_2004	-0.0966	0.0129	0.0227	0.0128	-0.0082	-0.0040	-0.0081	-0.0230	-0.0140	-0.0215
vacancy	-0.2305	-0.0666	-0.0881	-0.0586	0.0381	-0.1760	-0.2718	-0.3914	0.1549	0.0688
lag_vacancy	-0.3343	-0.0770	-0.0970	-0.0669	0.0408	-0.2242	-0.3114	-0.4566	0.1760	0.0236
D_exp_BS_YR	0.1029	0.0105	-0.0029	0.0343	0.0141	-0.1528	-0.0815	-0.0922	0.1201	0.0476
D_exp_GROSS	-0.0605	-0.0319	-0.0138	-0.0395	-0.0259	0.1019	0.0011	0.0144	0.0077	-0.0301
D_ti_0_1	-0.0188	-0.0866	-0.0806	-0.0736	-0.0374	-0.0571	-0.0520	-0.0498	-0.0095	-0.0167
D_ti_1_5	-0.0511	0.2244	0.1732	0.0524	0.0685	-0.0435	-0.0306	-0.0657	-0.0210	-0.0494
D_ti_5	0.1373	0.0645	0.0290	0.0455	0.0101	0.0789	0.0554	0.0863	0.0850	0.0814
D_lc_0_1	-0.1272	0.0760	0.1033	0.0894	0.0499	0.0383	0.0018	0.0006	-0.0562	-0.0377
D_lc_1_2	-0.0022	0.0678	0.0076	-0.0143	0.0011	0.0147	0.0107	0.0054	0.0168	-0.0089
D_lc_2	0.2339	-0.0860	-0.0723	-0.0494	-0.0330	-0.0553	0.0040	-0.0050	0.0451	0.0289

D_opt_renew	0.0688	0.3571	0.3126	0.2455	0.2147	-0.0255	-0.0471	-0.0692	0.0956	0.0828
D_opt_trmnt	-0.0432	0.2518	0.2310	0.0832	0.0420	0.0990	0.0720	0.0524	0.0502	0.0166
D_opt_rof	-0.0042	0.3744	0.3787	0.3319	0.2359	0.1023	0.0849	0.0615	0.0601	0.0402

	D_age~15	D_age~30	D_msa_~L	D_msa_~S	D_msa_DC	D_msa_~N	D_msa_~Y	D_msa_LA	D_msa~YC	D_msa_OC
D_age_3_15	1.0000									
D_age_16_30	-0.7457	1.0000								
D_msa_ATL	0.0573	-0.0618	1.0000							
D_msa_BOS	-0.0554	-0.1295	-0.0562	1.0000						
D_msa_DC	0.0265	0.0022	-0.0387	-0.0501	1.0000					
D_msa_DEN	-0.1037	0.1428	-0.0449	-0.0581	-0.0400	1.0000				
D_msa_EBY	-0.0394	0.0520	-0.0437	-0.0565	-0.0389	-0.0451	1.0000			
D_msa_LA	0.0831	-0.0995	-0.0574	-0.0743	-0.0512	-0.0593	-0.0577	1.0000		
D_msa_NYC	-0.0543	0.0230	-0.0228	-0.0295	-0.0203	-0.0235	-0.0229	-0.0301	1.0000	
D_msa_OC	0.1304	-0.0664	-0.0673	-0.0871	-0.0600	-0.0695	-0.0676	-0.0889	-0.0353	1.0000
D_msa_POR	0.0593	-0.0079	-0.0615	-0.0796	-0.0548	-0.0635	-0.0618	-0.0813	-0.0322	-0.0952
D_msa_SAC	0.1584	-0.1403	-0.0487	-0.0631	-0.0435	-0.0503	-0.0490	-0.0644	-0.0255	-0.0755
D_msa_SD	0.0092	0.0294	-0.0313	-0.0405	-0.0279	-0.0323	-0.0314	-0.0413	-0.0164	-0.0484
D_msa_SEA	-0.0657	0.1362	-0.0681	-0.0882	-0.0608	-0.0704	-0.0685	-0.0901	-0.0357	-0.1055
D_msa_SF	-0.0595	0.0357	-0.0753	-0.0975	-0.0671	-0.0778	-0.0757	-0.0995	-0.0395	-0.1166
D_msa_SJ	-0.1534	0.1504	-0.0699	-0.0905	-0.0623	-0.0722	-0.0702	-0.0923	-0.0366	-0.1082
D_msa_STM	-0.0093	0.0409	-0.0273	-0.0354	-0.0244	-0.0282	-0.0275	-0.0361	-0.0143	-0.0423
D_year_2001	0.1277	-0.1067	0.0159	-0.0032	-0.0014	0.0839	-0.0400	0.0591	0.0404	0.0024
D_year_2002	0.0952	-0.0466	0.0080	-0.0146	-0.0254	0.0011	-0.0422	-0.0069	-0.0257	0.0270
D_year_2003	-0.0097	0.0125	-0.0254	-0.0118	-0.0310	0.0056	0.0456	-0.0256	-0.0143	0.0197
D_year_2004	-0.0506	0.0331	0.0222	0.0245	0.0218	-0.0488	0.0338	-0.0061	0.0150	-0.0196
vacancy	0.0762	-0.0235	0.1730	-0.0959	-0.2069	0.0685	0.0487	-0.1184	-0.2004	-0.2402
lag_vacancy	0.0194	0.0236	0.1423	-0.1257	-0.1981	0.0121	0.0406	-0.0773	-0.1979	-0.1311
D_exp_BS_YR	0.0120	-0.0818	0.0510	0.1013	0.0754	-0.1982	0.1305	0.0435	0.0711	0.1758
D_exp_GROSS	-0.0003	-0.0347	0.0708	-0.0020	0.0185	-0.0232	-0.0501	-0.0083	-0.0289	-0.0314
D_ti_0_1	0.0309	-0.0116	-0.0288	-0.0505	-0.0265	0.0206	-0.0397	-0.0213	-0.0276	0.0146
D_ti_1_5	0.0397	-0.0074	0.0612	-0.0623	0.0078	0.0203	-0.0278	-0.0091	-0.0074	0.0253
D_ti_5	-0.0346	-0.0156	-0.0815	0.1280	0.0047	-0.0238	0.1211	0.0198	0.0068	-0.0606
D_lc_0_1	-0.0177	-0.0057	-0.0076	0.1456	-0.0309	0.0713	-0.0169	-0.0745	-0.0305	0.0245
D_lc_1_2	0.0575	-0.0019	-0.0147	-0.0705	0.0370	-0.0075	0.0411	0.0540	-0.0854	0.0111
D_lc_2	-0.0371	0.0138	0.0004	-0.0816	-0.0212	-0.0650	-0.0298	0.0288	0.1822	-0.0779
D_opt_renew	0.0681	-0.0399	0.0026	0.0276	0.0233	-0.0525	0.0565	0.0740	0.0033	-0.0254
D_opt_trmnt	0.0267	-0.0156	-0.0032	0.0100	0.0012	-0.0023	-0.0072	-0.0168	-0.0156	-0.0698
D_opt_rof	0.0379	-0.0281	0.0578	0.0205	0.0089	0.0267	-0.0106	0.0229	-0.0015	-0.0590

	D_msa_~R	D_msa~AC	D_msa_SD	D_msa~EA	D_msa_SF	D_msa_SJ	D_msa_~M	D_y~2001	D_y~2002	D_y~2003
D_msa_POR	1.0000									
D_msa_SAC	-0.0690	1.0000								
D_msa_SD	-0.0443	-0.0351	1.0000							

D_msa_SEA	-0.0965	-0.0765	-0.0491	1.0000						
D_msa_SF	-0.1066	-0.0845	-0.0542	-0.1181	1.0000					
D_msa_SJ	-0.0989	-0.0784	-0.0503	-0.1096	-0.1211	1.0000				
D_msa_STM	-0.0387	-0.0307	-0.0197	-0.0429	-0.0474	-0.0440	1.0000			
D_year_2001	-0.0281	-0.0267	-0.0385	-0.0120	-0.0350	-0.0800	0.0451	1.0000		
D_year_2002	0.0540	-0.0091	-0.0026	0.0024	-0.0059	0.0093	-0.0207	-0.1320	1.0000	
D_year_2003	0.0130	-0.0095	-0.0079	0.0099	0.0078	0.0065	-0.0266	-0.1463	-0.2928	1.0000
D_year_2004	-0.0200	0.0009	0.0139	0.0062	-0.0164	0.0115	0.0062	-0.1455	-0.2912	-0.3227
vacancy	0.1047	-0.0059	-0.0459	-0.1486	0.2955	0.0941	-0.0000	-0.0966	0.2729	0.2366
lag_vacancy	0.0569	-0.0219	-0.0114	-0.1239	0.3345	0.1054	-0.0289	-0.4115	-0.0838	0.2259
D_exp_BS_YR	0.1303	0.1186	0.0745	-0.1317	0.1127	-0.2136	0.0611	-0.0497	-0.0698	0.0207
D_exp_GROSS	-0.0388	-0.0090	-0.0134	-0.0361	-0.0340	-0.0078	0.0036	-0.0157	-0.0763	-0.0996
D_ti_0_1	-0.0179	0.0714	0.0194	0.0024	-0.0132	0.0811	-0.0058	0.0504	0.0533	0.0099
D_ti_1_5	0.1033	0.0245	0.0211	0.0280	-0.0938	-0.0347	-0.0256	-0.0102	0.0299	0.0025
D_ti_5	-0.0912	-0.0331	-0.0359	-0.0344	0.1200	-0.0693	0.0270	-0.0764	-0.0868	0.0092
D_lc_0_1	0.0452	-0.0454	-0.0581	0.0762	-0.0732	-0.0913	-0.0373	0.0304	0.0031	0.0060
D_lc_1_2	0.0116	0.0549	0.0401	-0.0145	0.0008	-0.0583	-0.0443	-0.0128	0.0344	0.0617
D_lc_2	-0.0391	0.0049	0.0050	-0.0796	0.0221	0.2600	0.0992	0.0335	0.0656	0.0288
D_opt_renew	-0.0389	0.1012	-0.0255	-0.0166	-0.0072	-0.0293	0.0930	-0.0627	-0.0883	0.0064
D_opt_trmnt	0.0373	-0.0218	-0.0358	0.0286	-0.0672	-0.0306	0.0050	-0.0503	-0.0445	0.0412
D_opt_rof	-0.0116	-0.0093	-0.0018	0.0297	-0.0383	-0.0770	0.0387	-0.0137	-0.0369	0.0089

	D_y~2004	vacancy	lag_va~y	D_exp_~R	D_exp_~S	D_ti_0_1	D_ti_1_5	D_ti_5	D_lc_0_1	D_lc_1_2
D_year_2004	1.0000									
vacancy	-0.0872	1.0000								
lag_vacancy	0.1860	0.7106	1.0000							
D_exp_BS_YR	0.1141	-0.1249	-0.0394	1.0000						
D_exp_GROSS	-0.0984	-0.0631	-0.0187	-0.4750	1.0000					
D_ti_0_1	-0.0331	0.0565	0.0041	-0.0164	-0.0516	1.0000				
D_ti_1_5	0.0342	0.0185	0.0183	0.0638	-0.1216	-0.3729	1.0000			
D_ti_5	0.0088	-0.0197	0.0522	0.0634	-0.0334	-0.1749	-0.4795	1.0000		
D_lc_0_1	0.0570	0.0269	0.0013	-0.0339	-0.0308	0.0261	-0.0211	-0.0115	1.0000	
D_lc_1_2	-0.0712	-0.0087	-0.0031	0.1038	-0.1326	-0.0338	0.1581	0.0531	-0.5950	1.0000
D_lc_2	-0.0591	0.0622	-0.0221	-0.0005	-0.0452	0.0174	-0.0200	0.0070	-0.1715	-0.3899
D_opt_renew	0.0555	-0.0083	0.0674	0.0782	-0.0095	-0.1126	0.1198	0.1146	-0.0497	0.1152
D_opt_trmnt	0.0403	0.0204	0.0378	-0.0573	0.0275	-0.0345	0.0682	0.0292	0.0147	0.0369
D_opt_rof	0.0095	-0.0051	0.0078	-0.0203	0.0307	-0.0773	0.0792	0.0448	0.0236	0.0458

	D_lc_2	D_opt_~w	D_opt_~t	D_opt_~f
D_lc_2	1.0000			
D_opt_renew	-0.0249	1.0000		
D_opt_trmnt	-0.0369	0.1837	1.0000	
D_opt_rof	-0.0627	0.3587	0.2142	1.0000