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Valuing retail lease options through time: Volatility spread between different types of retailers

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Abstract

Purpose – Retail properties are a perfect example of a property class where revenues determine the rent for the property owners. Estimating the value of new retail developments is challenging, as the initial revenues can have a significant variance from the long-term revenue levels. Owners and tenants try to manage this problem by introducing different kind of options, such as overage rent and extension rights, to the lease contracts. The purpose of this paper is to value these options through time for different types of retailers, using real-life data with a method that can be easily applied in practice.

Design/methodology/approach – This paper builds upon the existing papers on real option studies but has a strong practical focus, which has been identified as a challenge in the field. The paper presents simple mathematical equations for valuing overage rent and extension options. The equations capture the value related to uncertainty (volatility) that is missed by standard valuation practices.

Findings – The results indicate that overage and extension options can represent a significant proportion of retail lease contract's value and their value is heavily time-dependent. The option values differ greatly between tenants, as the volatilities can have a large spread across tenants. The paper suggests that the applicability of option pricing theory and calculus should not be considered as an insurmountable barrier any more, rather a greater challenge for the practical adaptability of the method can be the availability of real-life data that is a common problem in real option analysis.

Practical implications – The value of extension and overage options varies greatly between tenants. In general, the property owner can try balance the positive effects from the overage rents to the negative effects of tenant extensions. However, this study tries to highlight that, as usual, using the "law of averages" can result into poor valuation in this context as well. Even the data used in this study provide valuable findings for the property owner as an analytical deduction can be made that certain types of tenants have higher volatilities and this should be acknowledged when valuing options within lease contracts.

Originality/value – Previous literature in this topic often takes the input data for the option valuation as granted rather than trying to identify the real-life data available for the calculation. This is a common problem in real options valuation and it seems to be one of the reasons why option valuation has not been used widely in practice. This study has used real-life data to assess the problem and more importantly assessed the data across different types of tenants. The volatility spread between different types of tenants has not been discussed previously, even though it has a significant importance when using option pricing in practice.

Keywords Real option, Extension option, Option pricing, Overage rent, Retail lease, Revenue volatility

Paper type Research paper

Introduction

Retail properties are a perfect example of a property class where revenues determine the rent for the property owners. Estimating the value of new retail developments is challenging, as the initial revenues can have a significant variance from the long-term revenue levels. The first rental agreements are based on limited customer traffic information, which can create large variation between predicted and actual revenues. This revenue spread has implications for both the tenants and the owners. Both stakeholders try to manage this problem by introducing different kind of options, such as overage rent and extension rights, to the lease contracts. However, as option pricing

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techniques are not actively used in property valuation, the value of these options for both stakeholders is often unknown. This may result into not properly taking into account the option values in lease contract negotiation, as their value is not explicit for the stakeholders.

The main data needed for option pricing is the drift rate and the volatility. This paper applies a data-driven approach to value these options with a method based on Monte Carlo simulation (MCS). It is also valuable to identify the tenant specific data, as the tenant mix in shopping centers varies greatly and volatilities between the tenants should differ. This paper addresses the problems related to gathering real-life data for this kind of analysis. The purpose of this paper is to value these options through time for different types of retailers, using real-life data with a method that can be easily applied in practice. This paper builds upon the papers in this topic, especially Hendershott and Ward (2000), but with a strong practical focus, as it has been a challenge in applying real option pricing in practice (Adner and Levinthal, 2004; Vimpari, 2014).

The results indicate that overage and extension options can represent a significant proportion of retail lease contract's value and their value is heavily time-dependent. The option values differ greatly between tenants, as the volatilities can have a large spread. Based on the results in the case study, the tenant with the highest volatility (other retail sale), the overage rent varies through time from 8 to 29 percent of the base rent. For the tenant with the lowest volatility (books, newspapers and stationary), the overage rent varies from 3 to 22 percent. These represent the percentage of undervaluation of the lease contract, for these two different types of tenants. On the contrary, for the one-year extension options, the numbers vary from 12 to 15 percent and from 9 to 12 percent, which represents the overvaluation of the lease contract, from the owner's perspective.

The presented equations in the paper are easy to include into current valuation methods in simple spreadsheet formulas; and the mathematical applicability of option pricing should not be considered as an insurmountable barrier. Rather the practical adaptability of the method can suffer from data availability that is a common problem in real option analysis. In this study, the data were relevant for the case but not perfect, as the data were aggregated average of a nationwide sample. Nevertheless, the results point out the importance of understanding how volatility affects retail lease contract value and how it differs between different types of retailers. Furthermore, the effect of volatility is very important to understand in the context of the new developments as the revenue in the first years can vary largely from the long-term levels.

The research is organized as follows. In the following section, the methodology for valuing overage rent and extension options are presented. Then, data sources and results are presented. Finally, the findings are discussed in the last section.

Literature

Wheaton (2000) noted that retail is the only real estate sector where tenants pay a percentage rent on top of the fixed base rent. Wheaton discussed how the two components affect the tenant-landlord relationships and contracting. In short, tenants that draw customers into shopping centers (e.g. anchors) tend to pay a lower fixed rent and lower percentage rent because they promote the sales of the less-known and smaller tenants, which in turns pay higher percentage rents. This relationship requires the landlord to examine the center as a whole, as the tenants' sales affect the landlord's income. This does not occur this directly in other real estate classes, where the landlord is not dependant on the tenant's business success.

Hendershott and Ward (2000) recognized the problem of using linearly growing averages in property valuation and opened the discussion of using option pricing methods in valuing shopping center lease contracts. This research was built upon Grenadier's (1995) findings of pricing different kind of financial lease contracts. Hendershott and Ward (2000) recognized

several option-like features in shopping centers that should be priced with option pricing techniques: overage rent, expense stop, extension option and cancellation option. They explained that in the case of shopping centers, linear averages cannot capture the volatility in revenues. They argued that "uncertainty in sales can add substantial value. If sales rise, cash flows will increase; but if sales fall, cash flows remain constant. The more uncertain the sales, the greater the value of the shopping center."

Hendershott and Ward (2003) continued the research on this topic by focusing on overage rents and renewals. The paper builds upon the argument that "leases with overage rent clauses have lower base rents than straight fixed-rent leases with the same other terms, and leases with renewals have a higher rent than otherwise identical leases without them." The paper shows numerically in four different hypothetical contract settings what is the value of overage rent and renewals for both owners and tenants. The findings point that the initial rents can be structured in a way that these options are account for, and in a contract with both options, the initial rent can be structured to account for both of the options.

Ambrose *et al.* (2002) presented a stochastic pricing model for upward-only adjusting leases. The model is used to explain why initial rents should be significantly lower in upward-only leases compared to fully adjustable leases. Again, volatility has a significant meaning when pricing the contract properly.

Mooradian and Yang (2000) discussed cancellation option in commercial real estate leases, specifically analyzing the role of downsizing clause compared to full cancellation. They found that inclusion of a downsizing clause has a premium in rent, where a full cancellation option does not. The premium is paid by tenants with higher space needs and potential for future space reduction. The results suggest that property owners may use cancellation and downsizing clauses to differentiate tenants from low to high space reduction needs.

Sing and Tang (2004) addressed investor's leasing risk with a binomial option model; a default option is analyzed by addressing the costs from both lessor's and lessee's side in a case of lease renegotiation. The model increases the investor's understanding in embedded cancellation and default options in lease contracts.

Cho and Shilling (2007) used option pricing for valuing shopping center leases by delivering further evidence why the user-cost of capital does not hold in uncertain environments by claiming that it does not include the risk premium related to tenant risks. It was found that "positive value of the tenant's default option is roughly equal to the negative value of the overage or percentage rents in present value terms."

In general, it seems that the traditional property valuation logic misses the volatility effect in valuation, although the volatility can be very valuable as there are many option-like characteristics in retail lease contracts. The papers argue that these should be valued with option pricing techniques, as they are options because the downside is always limited to 0 and the upside may be significant.

Many papers in this context focus on the overage rent option and around the extension/renewal and cancellation options. The first represents a profit opportunity and the second two risks, for the property owner (see Table I). However, many of these studies, even though using sophisticated models for valuing the options, seem to have missed the discussion of real-life data sources used for the valuation. The data sources have been a part of the criticism toward real option pricing in general, even though majority of the criticism lies in the mathematical complexity of the methods (Lander and Pinches, 1998; Oppenheimer, 2002).

Methodology

Overage rent option

As revenues determine the value of the extension and overage rent options, we have to define equations how revenues are expected to change over time. If volatility is not taken

Option	Explanation	Data used in valuation
Overage rent	If tenant's revenues exceed a certain break point, the cash flow to the owner increases. The property owner benefits from uncertainty (volatility) in revenues, because the downside is hedged away with the fixed rent	Expected drift in revenues Volatility in revenues
Extension/ renewal	The higher the revenues, the higher the value of the extension option, for the tenant. The tenant will exercise the option if the revenues have increased sufficiently. However, the tenant has to consider relocation costs if relocating	Expected drift in revenues Volatility in revenues Expected drift in market rent Volatility of market rent (Relocation costs)
Cancellation	The lower the revenues, the higher the value of the cancellation option, for the tenant. The tenant will exercise the option if the revenues have not increased sufficiently. Again, relocation costs have to be considered	Expected drift in revenues Volatility in revenues Expected drift in market rent Volatility of market rent (Relocation costs)

Table I.
Common options in retail lease agreements

into account, the revenues change linearly based on a predefined drift rate, which is commonly based on historical data or other expected rate, such as inflation. When volatility is taken into account, revenue can be assumed to follow a discrete-time version of geometric Brownian motion, see the following equation:

$$R_{n+1} = R_n + R_n \times (d + \varepsilon \times \sigma) \quad (1)$$

where R is revenue, n is time, d is drift rate for the time period, ε is normally distributed random variable and σ is volatility for the time period. Therefore, if volatility is 0, the revenues are expected to change only based on the drift rate (that can be negative as well). As volatility is taken into account, we want to simulate a distribution for the revenues based on the drift rate, and on the volatility that has an expected normal distribution. For time n, the revenue is determined by simulating the equation a number of times. Figure 1 illustrates five simulations through time 1 to 10 with drift rate of 3.8 percent and volatility of 18.9 percent.

In the figure, the current revenue is 1,000 and threshold revenue is set as 20 percent higher, i.e. 1,200. Threshold revenue represents the level that the revenue has to exceed in order for the property owner to gain the extra overage rent from the tenant. The black line

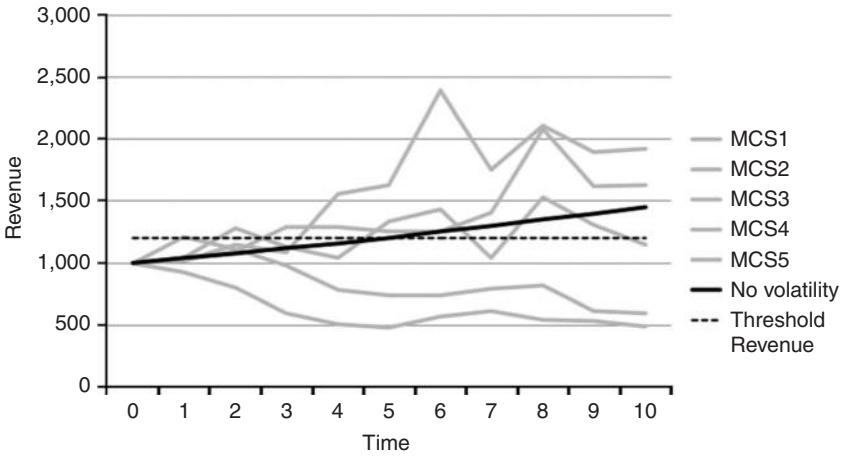

Figure 1.
Overage rent change through time with and without volatility

represents the no volatility case with a linear drift rate, i.e. the property owner would receive overage rent after time 5. The gray lines represent cases where volatility is taken into consideration, i.e. the revenue may exceed the threshold level much earlier than expected. As the base rent is not dependant on the revenue, the property owner has a call option on the revenues that exceed the threshold rent. In other words, the property owner should be interested on the probability that the gray lines exceed the threshold level because that will define the overage option's value. This is illustrated in Figure 2, where probability distributions are drawn from 10,000 simulations for six different time periods.

The figure illustrates how the probability of revenues exceeding the threshold level increases through time. For example, the direct cash flow analysis without volatility assumes that no extra rental value is created from time 1 to 5 because the threshold level is not exceeded. After time 5, it would be assumed that the probability is 100 percent. When volatility decreases, the probability that the revenue exceeds the threshold level increases, after certain time. However, decrease in volatility also reduces the value of the overage rent because the probability for higher revenues (right tail of the distribution) is reduced. This is very important to acknowledge when pricing the overage rent, because the property owner benefits from higher volatilities, as the downside is limited to the base rent.

In order to value the gray part of the distribution, the basic principles of option pricing is explained. The value of an option is calculated from the distribution that the underlying asset can have during its lifecycle. The distribution can be created with different types of methods; this study applies MCS, which is among Black-Scholes and Binomial Option pricing, one of the so called original option pricing methods. The option value is calculated

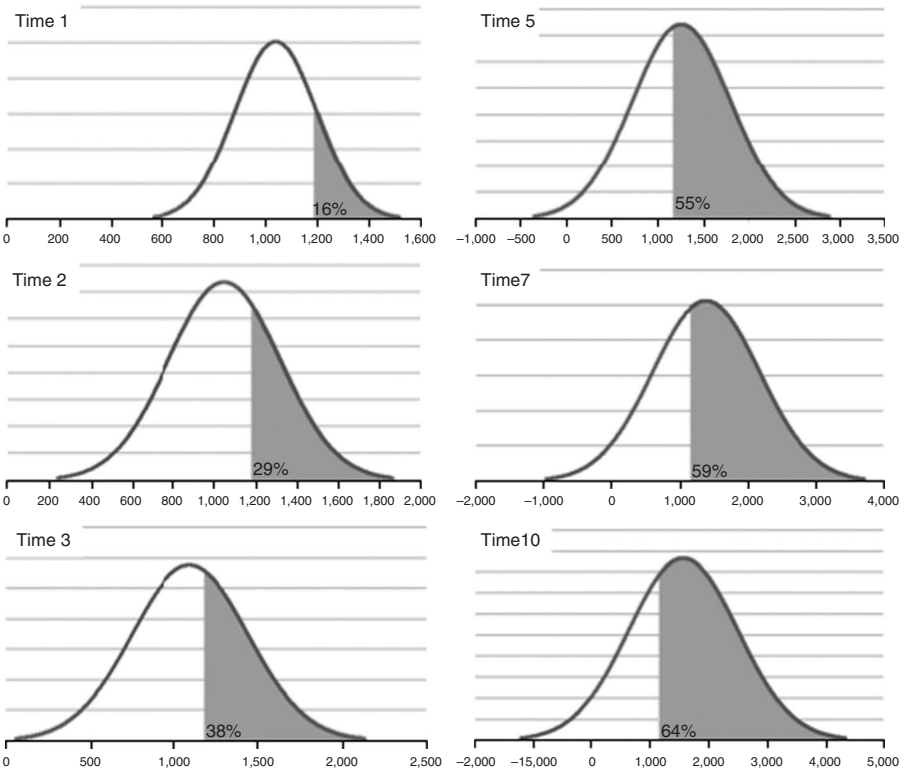

Figure 2.
Probability of revenues exceeding the threshold rent through time

as the average value of the positive area of the distribution, i.e. the option cannot have a negative value because the nature of the option is a right but not an obligation to do something. In this case, the option value is calculated from the average value of the revenues exceeding the threshold level. The option value represents the average missed rent for the property owner because volatility is not taken into account. The following equation is defined to value the overage option:

$$O_n = \left[\frac{\frac{1}{s}\sum_{i=1}^{s}(R_{ni} - T \vee 0)}{(1+r)^n} - \frac{\left(R_0 \times (1+d)^n - T\right) \vee 0}{(1+r)^n}\right] \times a \tag{2}$$

where O is the overage option value, i the number of simulation and s the total number of simulations, T the threshold revenue, r the discount rate used by the property owner, R_0 the revenue at time 0, d the drift rate, and a the overage rent fraction.

Extension option

Now we want to examine the value of the extension option as we have identified the value elements affecting the true value of the lease agreement. The tenant will exercise the extension option only if market rent is higher than the rent specified in the extension contract. The market rent is determined by real estate market conditions around the location, i.e. by demand and supply of comparable lettable space. In the case of shopping centers, the market rent determination is affected by subjects, such as customer drawing power, architectural design, location and general economics (Sirmans and Guidry, 1992) or by the nature of anchor tenants (Gatzlaff *et al.*, 1994). Furthermore, Mejia and Benjamin (2002) noted that the impact of spatial and non-spatial factors affecting shopping center sales. Non-spatial factors, most often retail image and mix, can have a great effect to the sales of shopping centers and should be considered together with the traditional determinants.

Based on these notes and Wheaton's (2000) above note on how the base rent and percentage rent differs between different type of tenants, we assume that the base market rent (without overage) is a percentage of the tenants' revenue and it follows an expected drift rate. It is common that the base market rent is given as a fixed rent (based on the location's supply of comparable space) rather than a percentage of sales, but this approach is used because we assume that the fixed rent is eventually determined backwards by the potential sales of the tenant (in the location). If the fixed rent is given as the base rent (e.g. € per sqm per annum), it can be transformed in to revenue by dividing it with the assumed percentage rent. Additionally, this approach can be used to determine the threshold for the overage rent revenue.

Tenants with higher volatility and/or drift in revenues are likely to exceed the base market rent in the shopping center when the contract is to be renegotiated. The extension option can be valued by modifying Equation (2) into the following equation:

$$E_n = \sum_{n=1}^{t}\left[\frac{\frac{1}{s}\sum_{i=1}^{s}\left(R_{n+1i} - R_0 \times (1+d_m)^{n+1} \vee 0\right)}{(1+r)^{n+1}} - \frac{\left(R_0 \times (1+g)^{n+1} - R_0 \times (1+d_m)^{n+1}\right) \vee 0}{(1+r)^{n+1}}\right] \times p \tag{3}$$

where E_n is the extension option value at year n, t the length of the extension, d_m the average drift of revenues for the shopping center and p the percentage of the revenue that determines the base rent. Rest of the parameters are as in Equations (1) and (2). It is worth noting that T in Equation (2) has been replaced with $R_0 \times (1+d_m)^{n+1}$ because the threshold level of the extension is based on the expected market rent that increases over time. In both Equations (2) and (3), the first part of the equation represents the value according to option

pricing (volatility included) and the second part of the equation represents the valuation based on linear increase of revenues (volatility not included). This means that the equations measure the value difference between option pricing and traditional linear pricing, i.e. the missed value between these approaches.

Cancellation option

Some real estate markets prefer longer leases with cancellation options, in contrary to shorter leases with extension options. The equation for the cancellation option formula is a mirror version of the extension option (Equation (3)):

$$C_n = \sum_{n=1}^{t} \left[\frac{\frac{1}{s}\sum_{i=1}^{s} \left(R_0 \times (1+d_m)^{n+1} - R_{n+1i} \vee 0 \right)}{(1+r)^{n+1}} - \frac{\left(R_0 \times (1+d_m)^{n+1} - R_0 \times (1+g)^{n+1} \right) \vee 0}{(1+r)^{n+1}} \right] \times p \tag{4}$$

The difference in the two equations is that the projected revenue is deducted from the market-based revenue in both parts of Equation (4). Thus, their place has been swapped compared to Equation (3). The reason is that the value of the cancellation option increases when the actual revenue decreases compared to the market-based revenue.

It should be noted that the cancellation option can be more valuable than the extension option, depending on the contract details. For example, if a ten-year lease has a continuous cancellation option after five years, it is an American option (can be exercised at any date between years 5 and 10). In contrary, a 5 + 5-year lease is a European option (can be only exercised at year 5). The cancellation option would be more valuable than the extension option as it would allow the tenant to postpone the decision to a later date.

Both Equation (3) and (4) assume that the option exercise is done at certain time (year n), but they can be used to evaluate both of the options. In the previous example, the cancellation option would have to be evaluated for all the times, depending on the contract details. e.g. if it could be exercised in yearly intervals between years 5 and 10, then it would have to be evaluated for years 5-10 separately compared to extension option that would have to be evaluated for year 5 only. The cancellation option would have a maximum value of the amount of year left of the contract at current point of time.

Findings

Data

This paper examines shopping center in Helsinki Metropolitan Area, Finland. As the nearby area of the shopping center is under development for a longer period, there is uncertainty from both the owner's and tenants' perspective in respect to the leases.

From a contractual perspective, the uncertainty can be handled with overage rent options and extension options. In the Finnish context, the extension option is the common option type in tenant lease contracts. Additionally, as the options are mirrors of each other, the cancellation option is not evaluated in the case.

Both of the options have important value that is tied to the volatility of the revenues of the building. Understanding the true value of these two options helps both of the stakeholders to understand the value of the leases. However, the method that we can use for option pricing depends on the data that we have. In this case, we want to measure the value of options for different retail tenants within the shopping center. The volatility is key part of the analysis, as it should differ for different type of retail tenants.

Equations (1)-(3) reveal the data sources for the calculus: drift rate (d), volatility (σ), current revenue (R_0), threshold revenue (T), overage fraction (a), discount rate (r), length of the extension option (t), market drift rate (d_m), the percentage of the revenue that determines

the base rent (p). Drift rate and volatility commonly differs between different types of retailers. These parameters have to be determined by historical data for MCS and have to be normally distributed due to the nature of Equation (1). The next three parameters are commonly negotiated in the lease agreement. Those are defined as the following: current revenue is 1,000, the threshold revenue as 1,200 and the overage fraction as 20 percent. Therefore, we are calculating the option value per 1,000 of revenue. Finally, the discount rate is set as 7.0 percent (based on an approximation of property market data). Length of the extension is one year, the market drift rate is defined as 3.8 percent (median of all examined retailers) and the base rent is defined as 10 percent of the revenues.

In essence, all expect the volatility and drift rates are determined by the property owner and the tenant in contract negotiations or by the market (the discount rate). The volatility and drift rate are those of interests, and should be based on actual data. In this case, we use data from Statistics Finland (2016) that has measured the average revenues of different retail types for 20 years. This data are available for 18 different retailer types and it can used to calculate the individual drift rates and volatilities, as presented in Table II.

Results

The data in Table II are applied into Equations (1)-(3) and the option values are calculated for different retailers. The results are presented in Table III.

For the overage option, the option value is calculated for every year from 1 to 10, i.e. the value in each column represents the present value of the option for that specific year. Then, from the property owner's perspective, the option value is the cumulative value of the columns, depending on the contract maturity. For the extension option, a one-year extension is valued for every year from 1 to 10, i.e. the value represents a one-year extension at that specific year. Naturally, if the extension is for more years, the option value is the cumulative value of these years.

The overage option values increase rapidly in the first five years and after that start to decline because the overage option value represents the missed value that is captured through option pricing, i.e. in Equation (2) the so called linear value is deducted from the pure option value; and after five years the linear value is expected to be positive because

Retail operator type	Volatility pa (%)	Drift pa (%)
Specialized stores	28.3	5.7
Other retail sale	25.7	5.6
Boats and boating accessories in specialized stores	24.7	4.5
Pharmacy, health care and cosmetic, toilet articles	22.3	5.2
Food, beverages or tobacco predominating	20.4	4.0
Home technology in specialized stores	20.3	4.4
Sporting equipment	20.1	4.6
Non-specialized stores	19.7	3.8
Department store trade	18.9	3.8
Furniture etc.	18.7	3.8
Hardware, paints and glass, wall and floor cov.	18.5	3.7
Optical equipment	17.8	3.8
Flowers, plants, seeds and fertilizers	15.7	3.1
Clothing, footwear and leather goods	14.8	2.5
Mail order houses or via internet	14.0	2.4
Automotive fuel	12.0	1.2
Watches and jewelry	11.8	2.3
Books, newspapers and stationery in spec stores	11.8	−1.1

Source: Statistic Finland (2016)

Table II.
Yearly volatilities and drift rates for different retail operators

Table III.
Overage rent and extension options values through time, per revenue

Retailer	Drift (%)	Volatility (%)	Option values for years 1 to 10 (€ per 1,000€ of revenue per annum)																			
			1		2		3		4		5		6		7		8		9		10	
			Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.	Ove.	Ext.
Specialized stores	5.7	28.3	10	13	23	15	34	16	37	18	36	19	34	19	32	19	29	20	28	20	26	20
Other retail sale	5.6	25.7	9	12	21	14	31	16	33	17	32	17	31	18	29	18	28	18	26	18	24	19
Boats and boating accessories	4.5	24.7	8	12	18	14	27	16	34	17	35	18	33	19	32	19	31	20	30	20	29	20
Pharmacy, health care and cosmetic	5.2	22.3	6	10	17	12	26	13	30	14	27	15	26	16	25	16	23	16	22	16	21	16
Food, beverages or tobacco	4.0	20.4	5	10	13	12	20	14	26	15	29	16	28	17	27	17	26	17	25	18	23	17
Home technology	4.4	20.3	5	10	13	12	21	13	27	14	27	14	26	15	24	16	22	17	20	17	19	17
Sporting equipment	4.6	20.1	5	9	13	11	21	12	28	13	26	14	25	15	23	15	21	16	20	16	18	16
Non-specialized stores	3.8	19.7	4	10	12	12	19	13	25	15	30	15	29	16	28	17	26	17	25	18	23	18
Department store trade	3.8	18.9	4	10	11	11	18	13	23	14	27	15	26	16	24	16	22	16	21	17	19	17
Furniture etc.	3.8	18.7	4	10	11	12	17	13	23	15	28	15	26	16	25	17	23	17	22	18	20	18
Hardware, paints and glass, etc.	3.7	18.5	4	9	10	11	17	13	23	14	28	14	26	15	25	15	23	16	22	16	20	16
Optical equipment	3.8	17.8	3	9	10	11	17	12	22	13	26	14	25	14	23	15	21	16	20	16	18	16
Flowers, plants, seeds and fertilizers	3.1	15.7	2	7	7	9	12	10	17	10	20	11	24	11	22	11	20	11	19	11	17	12
Clothing, footwear and leather goods	2.5	14.8	1	7	5	8	9	8	13	9	17	9	20	9	22	9	21	9	20	9	18	9
Mail order houses or via internet	2.4	14.0	1	6	5	7	9	7	12	7	15	8	18	8	20	8	21	7	19	7	18	7
Automotive fuel	1.2	12.0	1	4	3	4	5	4	7	4	9	4	10	4	12	4	13	4	14	4	14	3
Watches and jewelry	2.3	11.8	1	5	3	5	6	6	10	6	12	6	15	6	17	6	19	6	17	6	16	6
Books, newspapers and stationery	−1.1	11.8	0	3	1	2	3	2	3	2	4	2	4	2	5	1	5	1	5	1	5	1

the linear expectation exceeds the threshold rent. However, this same effect is not seen similarly when valuing the extension option because the threshold rent is expected to increase together with the market rent, i.e. every year the property owner sets (for new lease contracts) the threshold rent based on that year's numbers. Therefore, the present value of the extension option keeps increasing through the ten years.

The results seem to indicate that the option values increase together with drift and volatility. However, as the option pricing logics and previous literature suggest, the volatility should be the key driver of the option value. Figure 3 presents a sensitivity analysis for drift and volatility for the overage option.

As the figure points out, volatility is the main driver that increases option value rather than the drift rate. This highlights the importance of acknowledging the effect of volatility into pricing rents with different options. Therefore, in order to value properly the uncertainty in overage and extension agreements, using option pricing and focusing on volatility gives more reliable results of the real value of lease agreements.

We want to change these revenues into missed rent per square meter so that we can analyze the effect of these findings into actual retail space value. KTI (2016) measures the average revenues per sqm in shopping centers for some of the different retailers. The revenues are approximations calculated for Q1/2016 from KTI's database covering approximately 29 shopping centers in Finland, without taxes. They have been adjusted using Statistics Finland findings for different quarters and rounded down to hundreds. Table IV presents the revenues per retail type and the associated option values per sqm per annum.

The large difference in revenues between different types of tenants can multiply the option values. This is important to acknowledge when comparing different lease contracts with option characteristics. The results seem to indicate that in the first year, the one-year extension option is more valuable than the overage option and during the second year the overage option exceeds the extension value in cases where volatility is approximately over 20 percent. After that the overage option is more valuable than the extension option. It should be noted that in data section we have assumed that the base rent percentage is the same for all tenants (10 percent), which is not likely to case in reality. For example, Wheaton (2000) pointed out that this varies between different types of retailers. Thus, altering it between the retail operator types would have an effect on the comparability of the option values between retailers.

Finally, we want to compare the value of the lease contracts with and without the options, i.e. the property owner gains from the overage rent options but lose from

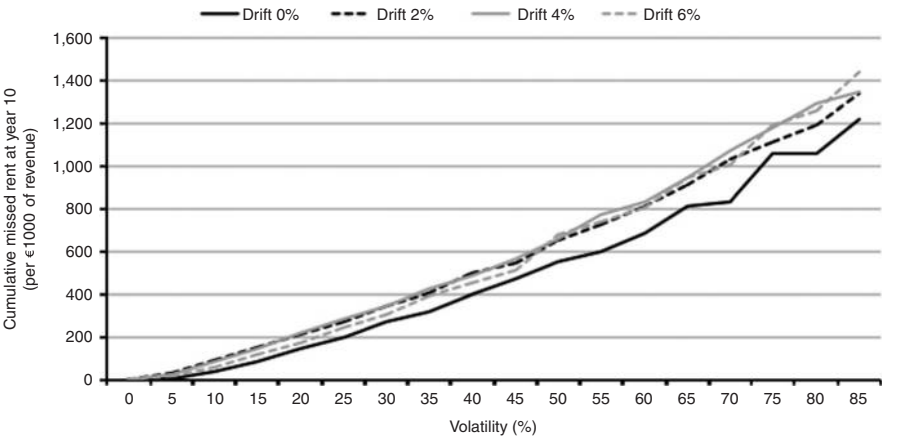

Figure 3.
The relationship between drift and volatility to overage option value

Table IV.
Overage rent and Extension options values through time, per square meter

Retail operator type	Revenue (€/sqm/a)	Option values for years 1 to 10 (€/sqm/a) 1 Ove.	1 Ext.	2 Ove.	2 Ext.	3 Ove.	3 Ext.	4 Ove.	4 Ext.	5 Ove.	5 Ext.	6 Ove.	6 Ext.	7 Ove.	7 Ext.	8 Ove.	8 Ext.	9 Ove.	9 Ext.	10 Ove.	10 Ext.
Other retail sale	2,900	25	35	60	41	89	45	97	48	92	51	89	52	85	52	80	52	76	53	69	54
Pharmacy, health care and cosmetic	8,400	52	86	139	100	219	109	253	116	230	123	221	132	208	133	196	134	187	137	177	138
Food, beverages or tobacco	3,800	18	39	48	45	77	52	99	56	112	59	107	63	102	65	99	66	95	67	89	66
Non-specialized + department store 1)	4,200	18	42	51	50	80	55	106	61	124	64	120	68	116	71	109	73	103	75	95	77
Furniture etc.	2,700	10	27	29	32	46	36	62	39	74	42	70	43	67	45	63	46	58	47	55	48
Clothing, footwear and leather goods	1,900	3	12	10	14	18	16	25	16	32	17	37	17	42	17	40	17	37	17	35	17
Books, newspapers and stationery	2,400	8	22	24	26	40	29	53	31	63	33	59	35	55	36	51	37	48	38	44	39

Note: Aggregated sales for both non-specialized stores and department store, volatility is similar with both

the extension options. Dividing the option value with the base rent does this. This analysis reveals that for the tenant with the highest volatility (other retail sale), the overage rent varies from 8 to 29 percent of the base rent. For the tenant with the lowest volatility (books, newspapers and stationary), the overage rent varies from 3 to 22 percent. These represent the percentage of undervaluation of the lease contract, for these two different types of tenants. On the contrary, for the one-year extension options, the numbers vary from 12 to 15 percent and from 9 to 12 percent, which represents the overvaluation of the lease contract, from the owner's perspective.

Discussion and conclusion

The results indicate that overage and extension options can represent a significant proportion of retail lease contract's value. The findings are similar to the previous studies in this topic, such as Hendershott and Ward (2000), Sing and Tang (2004) and Cho and Shilling (2007). Previous literature in this topic often takes the input data for the option valuation as granted rather than trying to identify the real-life data available for the calculation. This is a common problem in real options valuation and it seems to be one of the reasons why option valuation has not been used widely in practice. This study has used real-life data to assess the problem and more importantly assessed the data across different types of tenants. This has been missed by the previous literature and as the results point out, it is of significant importance when using options valuation.

As these results point out, the option values differ greatly across tenant types. Using average volatility to all the tenants can lead to inconsistent decisions. For example, extension options are much more valuable to other tenants and this should be acknowledged when negotiating the contracts, as they can pose significant risks from valuation perspective to the owner. The importance of this is highlighted in new developments, where the first years are the most volatile and the extension options can be of great value. Similarly, the value of overage options varies greatly, and they are more valuable in short-term than in long-term. In general, the property owner can try balance the positive effects from the overage rents to the negative effects of tenant extensions. However, this study tries to highlight that, as usual, using the "law of averages" can result into poor valuation in this context as well.

Even though this study found data for the different tenants in the center; the data are far from perfect as there are several limitations that would produce more accurate results. The data used in this study are the average volatilities and drift rates for the specific sectors within retail trade. This aggregated data naturally can decrease or increase the volatility and the option values for individual shopping centers. This is important to acknowledge when interpreting the usability of the results as larger volatilities can especially occur in new developments and areas. Accurate long-term data with identified tenant specific characteristics would improve the reliability of the results. However, the purpose of this study was to present equations for valuing overage and extension options, and to demonstrate their use for different types of tenants. Even the data used in this study provides valuable findings for the property owner. In general, an analytical deduction can be made that certain types of tenants have higher volatilities and this should be acknowledged when valuing the lease contracts.

Future research should focus on identifying more specific data sources, especially on how historically have the volatilities and drift rates developed in new developments. Additionally, as average lease lengths have been decreasing rapidly, it should be noticed that these kinds of options may have shorter interval and it would be interesting to value them with shorter time periods than one year. Furthermore, it seems that the transaction prices of new shopping centers may have large changes over a short-time period. It would be interesting to examine the role of percentage rents in these transactions, i.e. do some stakeholders in the industry recognize the option values more clearly in new developments and understand the potential in transaction negotiations.

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