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THE OWN-LEASE ANALYSIS DISCOUNTED CASH FLOW MODELS: A META-STUDY

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Problem/Purpose: The own versus lease decision is a complicated financial and strategic decision and corporates consider many financial and non-financial factors before reaching a conclusion. Calculating and comparing net present values (NPVs) of own versus lease (tenure) options' costs and benefits is a recommended practice in making decisions about forms of tenure. However, inspecting the literature's available models shows that the calculations include different cost and benefit variables as well as assumptions. This paper reviews five different discounted cash flow (DCF) own-lease analysis models in order to understand what the various models offer in making own-lease decisions.

Design/methodology/approach: These models used different cost and benefit variables within business and real estate cash flows, net real estate costs, net cash flows, net business and real estate cash flows, and cumulative cost savings. They variously used internal rate of return (IRR) and NPV as output parameters. Each model was tested using its 'native' dataset and a common dataset to identify which tenure options they arrived at.

Findings: The results provided by models mostly directed to the same recommendation – ownership. Only one model recommended leasing as a better option. This is interesting given the movement away from ownership of corporate real estate (CRE) and suggests that factors other than DCFs are emphasised in decision-making.

Research limitations/implications: One possibility is that the models do not fully capture the organisational economics inherent in the tenure decision. Not exclusively so, but the models tend to focus on real estate economics and do not fully capture the organisational consequences of real estate. These matters are examined with regard to the models' variables and those that might more fully capture CRE's organisational impacts.

Social Implications: The research is significant for academics teaching CRE tenure decisions and practical application for those using DCFs in their professional practice.

Keywords: Cash flow analysis, Corporate real estate, Leasing, Owning, Tenure decisions

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INTRODUCTION

Most organisations, at some stage, face decisions about their corporate real estate (CRE) tenure – to lease, to purchase or sell, or to continue owning. The existing literature provides several texts for understanding the financial and non-financial aspects of the lease versus buy analysis for corporate assets, for example, Lewis and Schallheim (1992), Sharpe and Nguyen (1995) and Smith and Wakeman (1985). Tenure decisions are more complex in CRE than ordinary tangible assets because they are appreciating assets rather than depreciating ones. Also real property has diverse intangible aspects associated it when put into business use (Manning, 1991; Redman and Tanner, 1991; Rodriguez and Sirmans, 1996). Another problem is that freehold tenure is not simply an alternative to leasing premises; it is also an investment decision. Therefore, analysis should incorporate finance and investment components (Ward, 1983; Golan, 1999). Financially analysis identifies the financial and investment advantage of one alternative over the other, and the alternative that will provide the needed space at the least net cost or highest return should be chosen. Though widely accepted that a discounted cash flow (DCF) analysis is the most appropriate methodology for these analyses, disagreements are exist in the literature regarding the cash flows and discount rates to be used (Miller, 2001). Because of these differences, models have different data requirements, can be interpreted differently, and may eventually lead corporations to make opposite decisions in similar financial circumstances.

Generally in real estate, different DCF formats exist for different purposes. For instance, valuation DCFs may consider depreciation at whole of asset level while in asset management depreciation is at the component asset level which requires a much more detailed treatment. In CRE, the literature provides several models for the own-lease analysis that exhibit all the issues for specifying cash flows and discount rates noted in Miller (2001). This, potentially, causes confusion and creates complications for both academics and practitioners. For CRE academics it is problematic as to what the best theory is and which is the best method to teach? For practitioners it is problematic in deciding which model to use to compare own and lease options. Much of the literature reviewed herein is quite dated suggesting that the theory is well settled. We do not completely agree which is why we feel that a study of a range of models would be useful.

This paper examines five distinctive own versus lease DCF analysis models published in international corporate and real estate texts to understand the financial recommendations they produced regarding CRE tenure and the basis of those recommendations. The paper has five sections. The following section reviews the literature concerning the tenure decisions for CRE. The methodology is then presented followed by the results. The concluding section highlights the key findings of the study and comments on the implications of these findings for professional practice.

LITERATURE REVIEW

Operational real estate is typically the largest asset type in an organisation's balance sheet (Lasfer, 2007), even in 2015 with decades of divesting owned CRE. Therefore, whether to lease or buy its operational space is one of the most critical investment decisions for organisations (O'Mara, 1999). Previous studies identify various rationales and motivations for leasing corporate real estate from financial and strategic perspectives. From a financial perspective, leasing allows organisations to avoid large upfront costs, obtain better financing terms, conserve liquidity, reduce leverage, mitigate potential agency conflicts associated with borrowing, reduce tax obligations and help companies grow faster (Lasfer, 2007; Lasfer and Levis, 1998; Clements and Engelstad, 2001; Sminski, 2000; Benjamin et al., 1998). Benjamin et al. (1998) adds other rationales for leasing, differential access to credit markets, ability to exploit landlord's property management economies of scale and risk management. On the other hand, companies can benefit from owning CRE through its use as loan collateral, use as a buffer stock in financial distress, altering it when necessary and using it as an inflation hedge (Lasfer, 2007). Companies that own CRE avoid rental commitments and also benefit from its capital appreciation.

Previous studies identify several, largely non-financial factors to consider when making CRE tenure decisions. These strategic and operational factors include the asset's required size, occupancy length, occupancy certainty, required control level of the property, nature of the industry, the firm's ownership structure, its leverage and financial constraints, degree of company-specific tenant improvements required, market cycle timing, existing market practices, cash availability of the firm, tax position, ease of property disposition and the firm's property portfolio size (Golan, 1999; Graham et al., 1998; Duke et al., 2002; Morais, 2014; Lasfer, 2007; Krishnan and Moyer, 1994; Adedeji and Stapleton, 1996; Benjamin et al., 1998; Sharpe and Nguyen, 1995). Weatherhead (1997) and Haynes and Nunnington (2010) summarise these factors as guidance for strategic and operational reasons for particular tenure forms. Similarly, there are strategic property classifications to guide tenure choices, for example, Gibler and Lindholm (2012).

Though many factors affect tenure decisions, the decision's financial basis is very important and for some, like Golan (1999), the decision is predominantly financial. Empirical studies show that there is little consensus as to the methodologies used in lease versus purchase decisions. Many previous theoretical models have employed the traditional discounted cash flow (DCF) approach to evaluate the tenure options (Smith and Harter, 2015). Within that approach it is a convention, as in Miller (2001), to calculate and compared the after-tax cost and benefits of owning or leasing the space. The tenure alternative with the best net present value (NPV) is then the financially supported one. Note that 'best' is used here rather than lowest cost or highest value because in CRE either cost-based or value-based DCFs could be calculated. This is possible because the default business view of CRE is that it is a cost against production, whereas real estate focuses more on real estate value aspects.

However, the existing literature disagrees about the cash flows and the discount factors that should be used within business and real estate cash flows and different discount rates such as weighted average cost of capital and interest rates (Miller, 2001). All the approaches also assume, at least implicitly at the moment of the decision, that the tenure decision is permanent. Options for future sale and leaseback or purchasing leased properties are ignored (Smith and Harter, 2015).

Several corporate and real estate reference and teaching texts (noted below) provide DCF models to assist lease-own CRE decisions. Broadly, they suffer the same problems noted above with different bases to cost and benefit variables are used within business and real estate cash flows, net real estate costs, net cash flows, net business and real estate cash flows, and cumulative cost savings. Output parameters variously include internal rate of return (IRR) and NPV.

Notwithstanding that different DCFs can be constructed for different purposes all these models purport to do the same thing – assist in financial analysis of CRE tenure decisions. And yet, each model exists without reference to previous offerings for constructing the model. Each is assumed to be 'new' and the 'right' way to do the analysis, notwithstanding the qualifications some models make that they are simplifications or illustrative of the technique. This suggests that a review of these models as a group would be useful in understanding what each contains, their basis of modelling and the results they produce.

RESEARCH PURPOSE AND RESEARCH DESIGN

This paper aims to analyse five distinctive discounted cash flow models provided in US and UK CRE texts in order to understand the financial recommendations for tenure decisions. No Australian text could be identified so international models needed to be used. These models were examined in order to answer the following questions.

- What variables (costs and benefits) do the various tenure DCFs contain?
- What results do they produce, that is, which tenure form is recommended from the calculation outputs?
- Is this consistent when their native data sets and a common data set are used?

The models examined in this paper are:

1. Internal Rate of Return of business and real estate cash flows (Brueggeman and Fisher, 2005, Chapter 15). This is a standard real estate analysis text;
2. Net Present Value of net real estate costs (Haynes and Nunnington, 2010, Chapter 3). This is the most current CRE text with an own-lease model;
3. Net Present Value of net cash flows (Nourse, 1990, Chapter 8). This is from the earliest CRE 'handbook';
4. Net Present Value of net business and real estate cash flows (Brealey et al., 2008, Section 12.1). This is from a standard corporate finance text that educates business financial managers; and
5. Cumulative cost savings (Brown et al., 1993, Exhibit 9.8). This is from the longstanding basic text in CRE.

To some extent, including Brealey et al. (2008) is anomalous. While it includes consideration of ownership and leasing the overall objective is to determine whether ownership for the designated business use is a particular site's best use. Nevertheless, we include it because it refers to tenure for business purposes and it is in a finance book which can represent a norm of business' CRE consideration.

A three-step research design was adopted. Step 1 examined the basis of the modelling and the variables and parameters used in the models. Step 2 compared the financial results using the models' native data sets and assumptions to see what tenure options were supported financially. Step 3 compared the financial results using a common data set. This required, in the first instance, identification of all the variables and parameters used across the models and preparation of a consolidated list of variables (as seen in Table 1). Next, a common working set of assumptions was required. For instance, several models used a single property purchase value whereas Brueggeman and Fisher (2005) separate this into land and building components in order to depreciate the building. Because of that the common data set used their land to building value proportions to divide an adopted purchase price for analysis. Similar assumptions were made for converting gross to net leases, real estate operating expenses, real estate terminal value, and proportion of costs attributed to transactions.

Table 1: Input parameters in the common dataset

Real estate cash flow	Input data and calculating percentages	Input data for analysis
Purchase price	$1,800,000	$1,800,000
Land value	12.5%	$225,000
Building value	87.5%	$1,575,000
Construction cost (per sq. ft)	12.5	12.5
Area (sq. ft)	105,000	105,000
Depreciation period – Building (yrs)	31.5	31.5
Depreciation period – Equip (yrs)	7.0	7.0
Annual depreciation of property		$50,000
Depreciated building value at end of period		$825,000
Corporate tax rate	30%	30%
Lease payment p.a. (gross)	$270,000	$270,000
Lease payment p.a. (net)		$180,000
Rental increase p.a.	4.0%	4.0%
Time period (yrs)	15	15
Real estate operating expenses	33%	$90,000
Real estate operating expenses increases	3.0%	3.0%
Terminal real estate value		$3,000,000
Net capital appreciation	4.0%	$1,080,000
Mortgage interest	9%	$162,000
Mortgage percentage of purchase price	76%	$1,368,000
Discount rate	10%	10%
Interest rate	10%	10%
Opportunity cost of equity	3%	$54,000
Acquisition costs (own)	4%	$72,000
Acquisition costs (lease)	3%	$8,100
Disposal costs (own)	4%	$120,000

Notes: Inputs in shaded cells are the variables common to all models
The analysis used sq. ft. because Brown et al. used that in their analysis (the only model that required area measurements) and because 4 of the 5 models were US-derived it made sense to use this basis for calculations.

RESULTS AND DISCUSSION

The first results relate to the basis of modelling, and the variables and parameters in the models (Table 2). These are then discussed before the two sets of results from the financial modelling are considered.

Modelling basis

As shown in Table 2, only three models used discounted cash flow models in their analysis. Brown et al. was, in effect, on a cash basis where the costs were inflated over the life cycle to show the likely cash outflows. However, Brueggeman and Fisher simplified their analysis by, effectively, using only the first-year figures as these are relatively more certain and assuming them as constant throughout the holding period. This obviates the second-guessing of future current cash flows. Of the three discounting models, two used Weighted Average Cost of Capital (WACC) for the discount rate and the other (Brealey et al.) adopted what appeared to be an indicative discount rate.[1] Nourse provided an extensive discussion of the merits of WACC as opposed to using discount rates specific to the risk of individual cash flows. WACC is advocated for its simplicity in practice and given that his model has a 'shareholder value-adding' premise a positive NPV using WACC will add economic value.

[1] We were tempted to use 'nominal' but that is used below with a specific meaning.

Table 2: Modelling basis and cash flow treatments

	Brueggeman and Fisher (2005)	Haynes and Nunnington (2010)	Nourse (1990)	Brealey et al. (2008)	Brown et al. (1993)
Origin	USA	UK	USA	USA	USA
Basis of analysis	Undiscounted	Discounted	Discounted	Discounted	Undiscounted
Basis of cash flows	RE & business cash flows	RE Costs (net)	RE & business cash flows	RE & business cash flows	Some building and some RE costs
Inflation treatment of cash flows	Constant (uninflated)	Unclear	Current (inflated)	Constant (uninflated)	Current (inflated)
Value basis	Real values	Unclear	Nominal	Real	Nominal
Tax treatment	After-tax	No information[2]	After-tax	After-tax	After-tax
Tax rate	30% (USA) RE partnership ownership structure assumed for leased asset	N/A	34% corporate tax rate (USA)	Not provided	34% corporate tax rate (USA)
Analysis period	15 yrs (lease term)	10 yrs ('standard' DCF modelling)	10 yrs ('standard' DCF modelling)	10 yrs. Break-even after 5 years	31.5 yrs (depreciable building life – USA) Cumulative cost savings after 10 years
Terminal value	Compounds at 3.5% (real) Net residual value after debt repayment	Compounds at 3.25% (real?)	Compounds at 1.35% (nominal?)	Increases at 3% (real?)	Building value depreciated to $0. Omitted as land values are not included
Treatment of capital gain	Taxed	N/A	Taxed	N/A	N/A because land value omitted and building value depreciated to $0
Discount rate	None – calculated IRR = investment opportunity costs	8% ≈ WACC	WACC	10%	N/A
Lease costs	Constant	Constant. Step-jump after Yr 5 of 30% (real/nominal?)	Current – Inflates at 5%	Increases at 3% (real?)	Current – Inflates at 2.5%. Step-jump after Year 5 (35% on initial rent & 22% on Yr 5 rates)
Yield/cap rate	10% ROI – 7% yield (real?) + 3% capital growth	5%	13.5%	10% for comparable retail property	N/A as land costs/value omitted
Interest costs	10% – makes mortgage payment equivalent to lease costs to simplify the analysis	7% on 70% loan-to-value ratio	Excluded	Not considered	10% Annual interest amount declines. Presumably capital repayments occur outside the analysis

[2]Commercial real estate investment capital allowances are not permitted in the UK, other than plant and machinery allowances. This is comparable with real estate depreciable allowances in Australia. Australia also permits capital allowances.

Table 2: Modelling basis and cash flow treatments (Part 2)

Equity contribution to ownership	25% of purchase cost	10% cost of equity	Working capital (reduces by 25% over the investment period)	N/A	N/A
RE expenses	Yes – net lease requirement.	Ownership and leasing 'service' charge assumed equivalent and ignored	Yes – net lease requirement. Fixed RE cost included in Admin. expenses Variable RE costs included in sales costs	N/A	Yes – 2.5% escalation
Business cash flows	Constant	N/A	Current – Inflates at 5%	Constant	N/A
	Sales – change in net sales income		Sales (net incremental change in network)	Sales	
	Equipment outlay				Excludes FF&E
	Operating expenses		Admin. expenses		
Output variables	IRR of business & RE cash flows	NPV of net RE costs	NPV of net cash flows	NPV of net business & RE cash flows Break-even point of business and real estate comparative investments	Cumulative cost savings Break-even point between options.

Note: WACC = Weighted Average Cost of Capital

Nominal-real basis of cash flows

It is not certain whether real or nominal values are consistently used within all the individual models. To some extent it does not matter which is used – they produce the same NPV and IRR results – provided the values are internally consistent within the model. Mixing them in the one analysis is incorrect. Brueggeman and Fisher's use of uninflated cash flows suggests that they use real values. However, their 7% yield figure and 10% mortgage costs meant that the figures could be either. There is an inclination for these to be taken as nominal values. Haynes and Nunnington used constant lease costs (other than the step-jump in Year 6), suggesting that these were real values. This is supported by the 3.25% compounding increase in terminal value and the 5% yield calculation. It is clear that Nourse used nominal values because inflation was included, and after-tax figures were based on these inflating cash flows. However, the terminal value's compounding at 1.35% (nominal) is confounding. Because the inflation rate used was 5% this suggests a negative 3.48% real discount rate though this might reflect the economic conditions in 1990 when the text was written. Brealey et al. appeared to use real values with constant business cash flow. A 10% discount rate could be real because with a, say, 5% inflation rate this equates to a 15.5% nominal figure as a hurdle rate which is high but not implausible. Brown et al. used nominal values. As the figures are undiscounted and the nominal-real concern is lessened because there is no discount rate, terminal real estate value and yield values. Its cash basis is, however, useful for understanding long-term budgeting.

Taxation and tax rates

The three of the four models calculated on an after-tax basis all used USA tax assumptions and rates. The fourth just adopted after-tax figures. Two adopted the corporate tax rate and the other employed US real estate tax law pertaining to what was assumed to be a real estate partnership holding the leased asset.[3] The two tax-using models that included land in their property concept also applied the corporate tax rate to the capital gain. The inclusion of tax treatment in the model also allows the inclusion of tax relief – depreciation of the owned asset (whole-of-building) and lease cost offsets against business's income in the lease option. Haynes and Nunnington did not consider tax treatment in their model. There are a couple of suggestions as to why this is the case:

- It is a simplified model to illustrate the application of DCF analysis; and
- They are from the UK and UK real estate tax provisions historically has had limited tax relief for commercial office buildings – typically plant, machinery and fittings (which are equivalent to Australia's 'depreciable assets'). Also, lease cost may not be deductable business expenses.

Yield and terminal value calculations

Notwithstanding the concerns about real or nominal basis of the variables noted above, we have calculated the property yields based on the owned option's initial purchase value and the lease costs in Year 1 of the lease. We can see that these are 'all over the place', varying between 5% and 13.5%. As these figures are from specific real estate markets, real estate cycles and particular real estate – all of which affect yields – it is difficult to make sense of the specific numbers. Nevertheless, Nourse's 13.5% seems high, even for a nominal figure. The figure may be reflective of the text's publication date being reasonably close to the 1987 Wall Street Crash where the property market was also shaken up. The other figures are more plausible and could represent reasonable figures to adopt for relating lease cost and capital values as inputs into the models.

Analysis periods

Three models used the same 10-year analysis period – incidentally the same as the discounting models. Ten years represents a fairly standard DCF period given the diminishing contribution from later, more highly discounted values and the difficulties in forecasting beyond 10 years. The period also equates to two 5-year lease periods – one initial term and one renewal. Brueggeman and Fisher's 15-year period explicitly relates to a lease term and is a reasonable basis of analysis if the alternative is (presumed) perpetual ownership. Their shorter mortgage period (10 years) for the owned option included a balloon payment equivalent to the NPV of remaining 5 years' lease payments – lease and mortgage costs having been assumed as equivalent to simplify the analysis. Brown et al.'s 31.5 year analysis period was based on the USA's depreciable life for buildings. Using the entire period obviates the need to consider residual depreciated value because the building value depreciates to zero over the period.

Financial costs

Most (4) models include finance costs in some way – usually as a cost of debt or equity in the owned option. Brueggeman and Fisher simplify the calculation by making this amount equal to the lease costs. Haynes and Nunnington make interest a constant annual amount. Brown et al.'s interest costs decline over time presumably because an interest only loan over 31.5 years is unrealistic. This declining interest cost in a cost-based analysis does privilege ownership in the longer term.

Nourse specifically excludes debt costs but he does include working capital in both options which is 'consumed' (declines) by 25 % over the ten years. Haynes and Nunnington make a not dissimilar assumption about the cost of equity tied up in the owned option's deposit. For Brueggeman and Fisher the comparable deposit is treated as an investment in the real estate's residual value.

[3] We do not claim to be fully expert on either the USA's or the UK's real estate tax provisions but the texts examined here provide more information on US real estate tax practice.

Lease costs

Three models clearly inflated lease costs. Nourse and Brown et al. did this with consistent increases based on annual inflation. In Brearley's case, given it uses real figures, then the escalation was based on increased real estate values (with yield constant, rents must correspondingly increase). Brueggeman and Fisher infer constant values by only using relatively certain first year data. Haynes and Nunnington also had consistent periods of costs but with a step-jump of 30% after Year 5. This equates to a 5.5% annual compound rate across the first five years. This is not implausible as a nominal increase but whether this could be a real increase is dependent on the state of the real estate market. Using the terminal value's appreciation rate of 3.5% p.a. produces a capital value of $2,375,400 meaning that the rental in Year 5 equates to 5.47% yield compared with a 5% initial yield. At 5% yield rental would produce a rent cost of $163,000. Notwithstanding the comments about connection to real estate markets this analysis shows that the numerical values in the model are not fully consistent. Brown et al. also included a significant step-jump after Year 5 of 22% on Year 5 levels (35% on initial rentals). In their case it supports an observation that the break-even point between ownership and lease costs occurs in Year 5. If more steady increases occur it is likely that the break-even point would shift dramatically beyond five years making leasing cheaper for much longer. This would most likely change their longer-term recommendation from owning to leasing.

Real estate costs (non-lease)

Most (4 out of 5) models incorporated non-lease real estate costs. Haynes and Nunnington acknowledge them but by assuming equivalence of real estate costs between options they omit them from their calculations. Where net leases are explicitly identified (Brueggeman and Fisher and Nourse) real estate costs applied to both options. In both instances they included amounts in the models but assumed the same amounts for each option. This inclusion could be useful should different properties be under consideration. Nourse separated real estate costs into fixed and variable components and subsumed the fixed real estate costs, like insurance, into his Business administration costs. Variable real estate costs that may vary depending on the amount of goods sold are subsumed into the cost of goods' amount. Both these costs inflated across the analysis period. Brueggeman and Fisher did not do this because constant values were assumed. Brown et al. consistently inflated them at 2.5% for only the owned option. Presumably real estate costs were included in the lease cost for the other option.

Business cash flows

Only two models included business cash flows in the modelling. As all models assumed that the tenure options were for the same property then business cash flows would presumably be the same regardless of tenure option. This does ignore the corporate real estate overheads that may be different for owned or leased options given that these could be higher for the owned option as they require a (slightly) more intense CRE management effort. Including business cash flow is immaterial if the same property is considered for both options. However, it is much more likely that different properties will be available for ownership or leasing. The different properties could materially impact on the business cash flows. This means that a tenure analysis should include business cash flows to allow for this.

Output variables and financial results

While different financial analyses here have the same objective – treatment of cash flows over time – different output variables are evident (Table 3). This is despite the assumption noted above that an NPV is the usual product of such analyses, through an IRR is also possible. Some of the differences in outputs here are due to the (non-)discounting of cash flows. The discounting models produce NPVs but from different specified cash flows. Brueggeman and Fisher's output is an IRR of a single year of undiscounted cash flows and Brown et al.'s undiscounted cash flows are compared on the basis of cost differentials and as accumulated over ten years.

While the numerical results are of interest, in regard to the tenure decision, the critical results is whether a tenure option is financially supported. Using the models' own assumptions and their 'native data', Table 3 shows that different tenure options are supported and these can vary over time. The first three models examined next provide an outright, definitive recommendation, but they differ as to which option is supported.

Table 3: Results delivered by each model using native data

Brueggeman and Fisher (2005)	Haynes and Nunnington (2010)	Nourse (1990)	Brealey et al. (2008)	Brown et al. (1993)
IRRs of business and RE cash flows	*Comparison of NPVs of net RE costs*	*Comparison of net cash flows*	*Comparison of NPV of net business and RE cash flows*	*Cost differentials and comparison of net cumulative costs*
Leasing : 12.501% Buying: 12.762%	Leasing: ($814,732) Buying: ($784,824)	Leasing: $4,139,424 Buying: $3,010,327	Income from retail business fails to cover the rental after 5th year	Leasing - $59,436,672 Buying - $36,136,741
Buying option supported	**Buying option supported**	**Leasing option supported**	**Owning option presumed and supported up to Year 5. Leasing option supported thereafter**	**Buying option selected** **Cost differential supports leasing up to Year 5**

Brueggeman and Fisher's internal rate of return (IRR) of business and real estate cash flows meant that the alternative with the highest IRR was the most appropriate tenure option. The own option's IRR was 12.76% while it was 12.05% for lease option, making owning the better financial option. For Haynes and Nunnington, in a cost-focused model, the lowest NPV of the cost and benefits of owning or the cost of leasing the space mattered. The leasing option's calculated NPV was -$814,732 while it was -$784,824 for owning option making owning the best alternative. Nourse's model calculated the NPV of all cash flows from the entire business activity rather than just the CRE-related costs. The analysis produced an NPV of $4,139,424 for the leasing option and a NPV of $3,010,327 for the purchase option, making leasing recommended as the best tenure option.

The other two models show recommendations that change over time. Brealey et al.'s initial analysis combining both of an owned option's business and real estate cash flows (albeit quite simplified) produces a positive NPV. This is noted as being very sensitive to terminal real estate values. The model was then developed by separating the activities into two businesses: a real estate subsidiary owning the property and a retailing subsidiary renting the property and running the business. By examined how much rent the real estate subsidiary should charge for the property and if retail subsidiary could afford to pay that rent ascertained the most profitable site use. If the retail business cannot afford to pay that rent, then the best option for the retail subsidiary is leasing another property more cheaply and leasing the existing property for the higher rent to a different organisation.

Based on the assumptions about real estate and business cash flows the model found that the constant business cash flows did not cover rising rents after 5 years. While considering the two business activities separately is logically defensible the model makes a category error in relation to the inextricable link between CRE and businesses, especially in the retail example. Changing to cheaper CRE may materially impact the business cash flows leaving the analysis in a comparable or even more parlous state if supporting ownership is the objective.

Brown et al.'s analysis differs in that they calculate after-tax total cost per area (square foot) as the output parameter with the cumulative costs after ten years the decisive financial result. The owing option considered the construction of a new building, ignoring the land, instead of buying a new property. Leasing was presumably on a similar basis – only the building. Under this method ownership had a higher total cost per area for an initial five years. However, from the sixth year onwards leasing was higher. This was due to inflating lease costs with a significant step-jump in Year 5 in the lease option whereas in the own option there were declining interest costs, somewhat counter-acted by inflating operating costs The recommended tenure was ownership in the long-run based on ten years of accumulated costs.

Largely, using the models' native data and assumptions the models support ownership recommendations, or make that a default assumption, as in Brealey et al. Nourse's model is at odds with that prevailing support. Two aspects contribute to this – the high yield meaning that for a given rental level the purchase value in the own option is low. Also, the terminal value's appreciation rate is very low meaning that the capital inflow at the end of the period is also very low. Both these factors bias the calculation against ownership.

The observed differences in support for tenure options provides challenges for potential users of these, and one imagines comparable models not analysed here. For practitioners interested in understanding which

method reliably supports tenure options there are questions about that reliability and the completeness in terms of organisational economics. For academics interested in understanding the most appropriate theoretical model for tenure decisions these results are inconclusive but nonetheless interesting in exposing the nature of the problem. When interested in which model for teaching the results appear downright confusing. This is especially so if the majority of analyses support ownership and there is a long-term trend away from that tenure form, this is not dissimilar to the general problem noted in the Literature Review that due to the differences in the input and output variables and assumptions used in the above models, they may be interpreted differently, leading firms to make opposite decisions in similar financial circumstances.

The next step of the research was to identify if these different outcomes persisted if they used a hypothetical common dataset applied to each model. Table 4 shows the output variables produced for each model by applying the common dataset presented in Table 1 above.

Table 4: Results delivered by each model using common data

Brueggeman and Fisher (2005)	Haynes and Nunnington (2010)	Nourse (1990)	Brealey et al. (2008)	Brown et al. (1993)
IRRs of business and RE cash flows	*Comparison of NPVs of net RE costs*	*Comparison of net cash flows*	*Comparison of NPV of net business and RE cash flows*	*Cost differentials and comparison of net cumulative costs*
Leasing : 12.501% Buying: 12.758%	Leasing: ($2,267,106) Buying: ($1,472,071)	Leasing: $10,703,286 Buying: $8,442,083	Income from retail business fails to cover the rental after 14th year	Leasing: $3,784,458 Buying: $1,965,048
Buying option supported	**Buying option supported**	**Leasing option supported**	**Owning option presumed and supported up to Year 14. Leasing option supported thereafter**	**Buying option selected** **Cost differential supports leasing in the short-term**

These results all directed to the same recommendation as the original recommendation. While we thought that this analysis may have changed the supported tenure option, on reflection, this result should not have been surprising. This is because it was found necessary in translating the common data set for use in each of the models' variables we made the same assumptions that each model made itself. Hence, we achieved the same results. Nevertheless, we think that there is more investigation possible with these models perhaps by translating not only the data but also the assumptions from one model to another. For instance, whether by recalculating Nourse's model using Brueggeman and Fisher's assumptions makes a difference to Nourse's supported tenure option.

A DCF analysis is recommended as a key component in making tenure decisions. For some, like Golan (1999) (and presumably others) the decision is a financial one. Nevertheless while recommended practice it is unclear what benefit DCFs are providing in making tenure decisions for several reasons.

First, there is a long-term movement away from ownership of CRE suggesting that factors other than DCFs are emphasised in decision-making. There are possible strategic and operational reasons for selecting a particular tenure form – see, for example, Weatherhead (1997), Benjamin et al. (1998) or Haynes and Nunnington, (2010). These provide rationales for decisions contrary to whatever financial analysis produces.

Second, among the qualitative factors in play is the property or properties under consideration. The models had an underlying assumption that a single property under consideration. Real estate market opportunities almost certainly mean that different properties are available for ownership and leasing with different impacts on other business costs. This means that any model should accommodate differences that can occur in both real estate and business cash flows. Only three models here did that in any fashion. Even then, they tended to be real estate only analyses tending to rely on real estate economics answering real estate questions. They make little or any reference to the (financial) impact on the business. This seems inadequate as CRE is embedded in many organisational processes and financial implications. It also seems inadequate because CRE has evolved from a more pure real estate discipline to where being a Business Strategist is best practice (after Joroff et al. (1993)). This means that DCF modelling needs to answer business questions that contain real estate dimensions.

Third, if these are the standard guidance in CREM on how to do DCFs[4] then they support a variety of tenure options and the options are more that the own-lease binary pair. That is they all do not point towards the same option. They tend to support ownership either by analysis or by first assumption. Nourse is the exception but even that exception shows the inconsistency of support. It might also mean that in selecting one of these on which to base a financial analysis whichever you choose may bias you towards one option rather than another. This can, of course, depend on the numerical parameters adopted into the model. The analysis also shows that, depending on the model, the financial basis to the decision may not be permanent, as noted by Smith and Harter (2015). Without going to option price theory this analysis shows that depending on the modelling approach adopted and what it includes can change the financially supported decision over time.

CONCLUSION

The tenure decision requires multiple factors be resolved in arriving at a conclusion. The financial dimension is an important factor and the variables included in the financial model are therefore central to the outcome. The received wisdom is that Discounted Cash Flow models are the most appropriate analysis technique in such evaluations.

The analysis of five distinctive tenure financial models provided in international corporate finance and real estate texts showed various techniques were recommended – not all of them were DCFs. They included a variety of assumptions about the objects under analysis – business, real estate or only its building improvements which have issues when strategic CRE management is important. They make a variety of simplifications in the modelling either for practical reasons or because the author(s) note that the example is only illustrative of the DCF technique. They showed a variety of ways to deal with changes in cash flows over time – treat them as constant (real values) or vary them by inflating them (current values) or by making assumptions about how they might change at, say, rent reviews after five years. To an extent it does not matter if real or current values are used but there was a suspicion that is not fully assuaged by this analysis that some models blend the two approaches.

The models produced a variety of positions in support of one or other tenure option that is attributable to the assumptions in the models' structure and their disparate data. The paper addressed the latter by adopting a common data set which did not change the particular model's supported recommendation. This suggests that further research is required to more fully examine the assumptions and the structures of the models.

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[4] Clearly this is contestable. Nevertheless there is some support for this statement because in CRE teaching or learning and needing a 'textbook' then these texts (with the possible exception of Brealey et al.) are most of the primary texts, and more so if one wants tenure financial models.

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