REVALUE

Cash Flow Components

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Executive summary

The capital value of rental properties is a function primarily of the expected income and costs associated with the asset in the future and the discount rate applied to the subsequent cash flow. When an estimate of the likely transfer price in the market of an asset is concerned, it is also influenced by the sales prices achieved of other similar properties in the market. Thus, property valuation requires the consideration of numerous sources of revenue, cost, and risks associated with the asset, together with an analysis of market conditions and strength of the transaction market, to give an accurate estimation of its present value.

There are two main methods used to calculate the value of investment properties: one is through the assessment of net rental flows capitalised at a yield derived in the market; this is normally known as Market Value (MV). The other is through the use of a discounted cash flow (DCF) in which the discount rate is based on the expectations of an specific investor or group of investors; this is normally known as Investment Value (IV).

This note surveys the literature exploring the different channels through which energy efficiency might affect the final value of a property. It uses the discounted cash flow (DCF) method as a framework to explore the factors to be considered when computing the present value of a property. In a DCF valuation exercise, property values are the discounted sum of net operating income over the investment period and the discounted terminal value at the investment horizon. Based on this framework, we describe the empirical evidence exploring the link between energy efficiency and each value component. The emerging academic literature provides empirical evidence from the market place showing that energy efficient buildings tend to be rented at a higher price, have higher occupancy rates and may be sold at a premium. These channels would ultimately have a positive impact on the final assessment of value of a property by expert valuers.

The results of the literature should be extrapolated with caution, especially in relation to affordable housing. The overwhelming majority of the studies published in this field does not concern affordable rental housing specifically. Social Housing providers are subject to special rules and regulations facing important constraints to raise rents that might prevent them from the sources of value described above. For instance, the inclusion of rental caps would prevent these institutions from benefiting the rent increases associated with the higher willingness to pay by tenants found in previous studies.

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Chapter 1 Introduction

Studying the impact of energy efficiency on property valuation requires the analysis of the effect of energy efficiency on the different cash flows generated by an asset. We base our discussion on the widely used discounted cash flow (DCF) model, acknowledging that this is not the method normally used for assessing value in the market place, especially for owner-occupied properties. In the DCF framework, the total value effects of certain property characteristics, like a building's energy efficiency or general sustainability performance, are based on the changes in the discounted cash flows associated with these energy features.

The discount rate is normally based on the individual investor's required return taking account of their opportunity costs and their general perception of risks associated with the asset. Even if energy efficiency would have no discernible effects on cash flows, it could still affect value through the discount rate used to calculate the present value of cash flows. If energy-efficient buildings are easier to sell, for example, lower liquidity risk or shorter lease-up periods would lead in a lower required risk premium and a lower discount rate.

The purpose of this deliverable is to use the framework of discounted cash flow valuation for a systematic discussion of the different components determining the value of rental housing based on an up-to-date review of the scientific literature on this topic. In order to do that, the document will begin with a section on the theory of value, providing the present value formula for rental housing, and a short discussion of each of its components. The next section will provide empirical evidence regarding the effects of energy efficiency on each component, with Section 3.1 focusing on rental cash flows, occupancy, and operating costs; Section 3.2 discussing terminal value; and Section 3.3 discussing the yield. The deliverable will end with a short summary and some conclusions.

Chapter 2 A theory of value

This section provides a description of the discounted cash flow (DCF) method for property valuation, where the current value of a rental dwelling (or any other asset held as an investment) is determined by the discounted sum of its projected net operating income over a given time horizon and the present value of its terminal or exit value.[1] The DCF model describes the value of a given asset as follows:

$$PV = \sum_{t=1}^{T} \frac{NOI_t}{(1+r_p)^t} + \frac{TV}{(1+r_p)^T}$$

Where *PV* describes the (current) value of a property, which is equal to the present value of the discounted sum of the property's (expected) net operating income (NOI_t) every year over the investment period (T) and the present value of its terminal or exit value (TV). NOI_t is based on the difference between rental income and costs. The DCF formula shows that two buildings generating the same cash flows can still have different values, if their discount rates r_p would be different. This could be the case, for example, if these buildings would have different levels of risk. In the case of a Market Value the discount rate will be a reflection of the general *market* perception of risk; or IV it is the individual investor's view.

The basis for computing the discount rate r_p is discussed extensively in ReValue-Deliverable 3.5. For the purposes of this theoretical paper it is taken as the weighted average cost of capital (WACC):

$$r_p = (LTV)r_D + (1 - LTV)r_E$$

where r_D and r_E describe the return on debt and equity on the asset, correspondingly, and LTV represents the loan to value ratio (Geltner *et al.* 2013). The rate of return on debt, r_D is the risk-free interest rate. The rate of return on

[1] For a theoretical discussion on integrating sustainability measures in property valuation see Lutzendorf and Lorenz (2011).

equity, r_E, is the exposure of the asset to the market risk, that depends on liquidity risk and vacancy risk. As noted in ReValue Deliverable 3.5 this area of study is not yet well explored through literature.

Chapter 3 Empirical evidence on the components of value

This section provides the state of the academic literature regarding the components of value, with each of the subsections containing information on one of the valuation components discussed above.

Net operating income: Rental cash flow, vacancy, and costs

The net operating income (NOI) is the result of subtracting the vacancy and operating expenses from the rental income generated by the property.

Rental cash flows

Most of the current evidence on the link between energy efficiency and rents focus on commercial real estate. In their review of the literature, Dalton and Fuerst (2018) have identified approximately 30 papers investigating rental effects, of which 24 concern commercial real estate, and only 7 study housing. To the knowledge of the authors, none of these papers relies on a sample of affordable (rental) housing. Among the papers studying housing rents, two studies involve data for the United States (Bond and Devine 2016; Koirala et al, 2014), one for China (Zheng, et al., 2012), one for Ireland (Hyland, et al., 2013), one for Germany (Cajias and Piazolo, 2013) and one for Switzerland (Feige, et al., 2013).

Thus, the academic literature regarding energy efficiency and its potential effects on rental cash flows in residential real estate is still relatively scarce, and it is of a rather recent vintage. Nevertheless, there is a clear consensus in the findings. The general conclusion drawn in this literature is that rents of energy efficient dwellings are higher than their low energy efficient counterparts, after controlling for other rent-influencing factors like location, size, age, and overall property quality. Dalton and Fuerst (2018) show that all the statistically significant green effects are positive. The average effect on rentals found in the literature is 8.2 percent, with a 95 percent confidence interval – based on a meta-analysis of this literature – ranging from 2.4 percent to 14.1 percent (Dalton and Fuerst, 2018). However these studies were all of market situations and will clearly not prevail in the case where rent levels are capped, which is the situation for social housing.

Overall, this effect is somewhat higher than it is for commercial real estate, for which the available papers report an average rental premium of 5.4 percent, with a confidence interval ranging from 3.7 percent to 7.2 percent.

Vacancy and operating costs

To the knowledge of the authors, the evidence exploring the link between energy efficiency and property vacancy focuses fully on commercial real estate in the US. Eichholtz, Kok and Quigley (2010) report that the occupancy level of green office buildings is 11 percent higher than of otherwise comparable non-green ones. Fuerst and McAllister (2011) show occupancy rates between 1 and 3 percent higher for green office space, while Wiley, Benefield and Johnson (2010) and Reichardt et al (2012) find occupancy premiums of 11 percent and 4.5 percent, respectively. Eichholtz, Kok and Quigley (2013) also report higher occupancy for green office space, but do not provide an estimate of the magnitude.

Regarding the operating costs, many papers state that operating costs of energy efficient buildings, either commercial or residential, are lower. However, to the knowledge of the authors, there is a shortage of empirical evidence supporting those claims in the field. A recent study in the UK estimates average fuel savings of 150 pounds per month between "G" and "A" rated homes, for a family of four members (UKGBC, 2017). If indeed energy-efficient buildings have lower energy spends, those savings tend to go to the tenant rather than the landlord. The energy savings might well be translated in an increase in an increase in willingness to pay for energy efficient houses by tenants, however they will not necessarily reflect through to rent in the affordable rental sector - as these institutions face rental caps. Thus, the direct benefits for the owners of the rental properties and ultimate impact on the value of the property are not fully clear.

Exit value

The terminal or exit value refers to the likely sale price of the property at the end of the investment holding period. The exit value can either be estimated by the infinite expansion of the last period's (T) cash flows or based on a set of comparable dwellings in the area of the property that were transacted recently in the open market. The impact of energy efficiency on this factor is reflected in the expected differences in market prices of comparable dwellings (i.e. similar location, size, and amenities) with different levels of energy efficiency.

The literature provides evidence of house price differentials associated with energy efficiency, either measured by energy consumption or energy indexes (e.g. EPC labels). A recent meta-analysis of the literature identifies a total of 35 academic articles investigating the link between property sale prices and energy efficiency, including 18 focusing on the residential sector. The listed studies provide evidence of significant differences in transaction prices of dwellings in different regions of the world, with an average premium of 5.5 percent - ranging from 3.6 to 7.5 percent. These price differentials are higher in mainland Europe and Australia (Dalton and Fuerst, 2018). In this literature, the only paper specifically focusing on affordable housing is Chegut, at al. (2016), and it shows a 6 percent value premium of A-labelled dwellings relative to E-F labels. [2]

The discount rate

The accompanying note in the ReValue project provides empirical evidence regarding the level and determination of the discount rate.[3] This subsection only gives the main conclusions. As we discussed in Section 2, the discount rate is based on the weighted average cost of capital, and has two main components, the cost of debt, and the cost of equity. There is some literature regarding the effect of energy efficiency on these two components, but most of that literature regards real estate assets in general, and is not specific to housing. Nevertheless, we will discuss this literature here, as this is the best currently available knowledge on the topic.

The literature regarding the relationship between real estate's environmental performance and the cost of capital is still rather thin, but it does provide a clear consensus in terms of the direction. The first main takeaway is that energy-efficient real estate has lower vacancy and liquidity risk, translating into a lower beta – the measure of systematic equity risk. Probably as a result of that, the equity cost of capital of environmentally certified real estate is lower by 38 basis points. Second, the cost of debt financing for energy-efficient real estate is approximately 30 basis points lower than for conventional real estate. The exact effect on the weighted cost of capital and therefore on the discount rate that needs to be used for present value calculations depends on the leverage applied.

While these are the best estimates the literature currently provides, it is not clear to what extent these numbers hold for rental housing. But a safe conclusion seems to be that the appropriate discount rate for energy-efficient rental dwellings is lower than of non-effiicient ones, given the lower specific risks of the former.

Chapter 4 Discussion and conclusions

This note provides insights into the components of investment value based on the discounted cash flow model. While the academic literature provides evidence on most of these components, the available evidence should be interpreted with some caution when used as inputs for the valuation of affordable rental housing. This is because the overwhelming majority of the studies published in this field do not concern affordable rental housing specifically. Of the studies covered in Dalton and Fuerst's (2018) comprehensive meta-analysis, approximately two thirds involve commercial real estate, and only one third housing. Of the latter group, only one, Chegut, Eichholtz and Holtermans (2016) concerns affordable housing.

That does not imply that the findings in the literature would not be relevant, however. First, the international literature has resulted in a notable consensus and consistently shows significant value and rental premiums, both for commercial and for residential property. Second, the variation across these studies, which cover a multitude of countries and property markets, is surprisingly small. The overall residential rental premium is 8.2 percent – with a 95 percent confidence interval ranging from 2.4 percent to 14.1 percent. For residential property, the overall average green value

[2] For an extensive discussion on the impact of energy efficiency on sale prices see ReValue Deliverable 3.3.
[3] See ReValue Deliverable 3.5 for a deeper discussion about the link between energy efficiency and the cost of capital of real estate investments.

premium is 5.5 percent – with the 95 percent confidence interval ranging from 3.6 percent to 7.5 percent. This latter value premium is comparable to the one reported by Chegut, Eichholtz and Holtermans (2016) for vacant affordable dwellings sold on the open market. In sum, the literature shows a consistent willingness to pay for energy efficiency by both home buyers and tenants.

But a willingness to pay does not automatically imply that payments are made, especially in the case of affordable housing. National rules and regulation may preclude affordable housing landlords from raising the rents of their energy-efficient dwellings, even if tenants would be willing and able to pay higher rents commensurate with their lower monthly energy bills. Or the rules may prohibit them from selling their dwellings to willing buyers, preventing them from realizing the higher terminal values shown in the literature. In other words, the local institutional setting should be taken into consideration when judging the relevance of the cash flow effects of energy efficiency for affordable housing.

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