Real Estate Financing and Interest Rate Hedging

A quantitative real estate investment case study
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Abstract

Background: The expansive monetary policy of the European Central Bank has been leading to all-time-low interest rates and to a strong move into real estate investment. Low interest rates can work in favor of the investor (due to low interest rate expenditures), but increasing interest rates can jeopardize real estate investments. Since changes in interest rates are unpredictable, an investor needs to deal with this volatility. The capital market offers several financial instruments (so-called “derivatives”) to overcome the above-mentioned obstacle. There is no “one-size-fits-all” strategy. The investor needs to decide which financing structure to combine with which form of derivative.

Purpose: The investigation not only explains and shows how real estate financing and hedging strategies on a given project in Germany can work but also explains why it is crucial to link these segments. To achieve this purpose, the return on equity and return cash flows at risk are numerically estimated. The evaluative purpose will be served by using the above-mentioned ratios and cash flows to derive recommendations of action. In doing so, this study will illustrate the importance of hedging, particularly for real estate investors and investors in general.

Method: Interest rates on a monthly basis for the period of June 1990 until March 2017 from Thomson Reuters Eikon and real life data from a German real estate investor and a German financial institution were collected. Thereafter, these numbers were used as a basis to perform interest rate and cash flow simulations (Monte Carlo). The simulations were used to determine superior financing and hedging strategies for the investor.

Conclusion: The results of this study highlight the benefits from leveraged financing and the necessity of interest rate risk management (hedging) to obtain stabilized future cash flows and reduce volatility caused by fluctuating interest rates. Fixed rate loans offer protection against rising interest rates, but lack flexibility. Floating loans offer more flexibility but are riskier due to the unhedged interest rate exposure.
<table>
<thead>
<tr>
<th></th>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction ......................................................................................................</td>
</tr>
<tr>
<td>1.1</td>
<td>Background ...........................................................................................................</td>
</tr>
<tr>
<td>1.2</td>
<td>Company and bank ...............................................................................................</td>
</tr>
<tr>
<td>1.3</td>
<td>Problem discussion ..............................................................................................</td>
</tr>
<tr>
<td>1.4</td>
<td>Purpose and research questions .........................................................................</td>
</tr>
<tr>
<td>1.5</td>
<td>Delimitation ..........................................................................................................</td>
</tr>
<tr>
<td>1.6</td>
<td>Disposition ...........................................................................................................</td>
</tr>
<tr>
<td>2</td>
<td>Theoretical framework ........................................................................................</td>
</tr>
<tr>
<td>2.1</td>
<td>Forms of real estate ............................................................................................</td>
</tr>
<tr>
<td>2.2</td>
<td>Investing in real estate .......................................................................................</td>
</tr>
<tr>
<td>2.3</td>
<td>Financing real estate ...........................................................................................</td>
</tr>
<tr>
<td>2.4</td>
<td>Risk Management ..................................................................................................</td>
</tr>
<tr>
<td>2.5</td>
<td>Instruments ...........................................................................................................</td>
</tr>
<tr>
<td>3</td>
<td>Previous studies ....................................................................................................</td>
</tr>
<tr>
<td>4</td>
<td>Methodology ...........................................................................................................</td>
</tr>
<tr>
<td>4.1</td>
<td>Research approach and method ...........................................................................</td>
</tr>
<tr>
<td>4.2</td>
<td>Data collection and data input ..........................................................................</td>
</tr>
<tr>
<td>4.3</td>
<td>Assumptions within the analysis .......................................................................</td>
</tr>
<tr>
<td>5</td>
<td>Empirical findings ................................................................................................</td>
</tr>
<tr>
<td>5.1</td>
<td>Risk factor ..........................................................................................................</td>
</tr>
<tr>
<td>5.2</td>
<td>3M EURIBOR simulation .......................................................................................</td>
</tr>
<tr>
<td>5.3</td>
<td>Fixed rate ............................................................................................................</td>
</tr>
<tr>
<td>5.4</td>
<td>Floating rate without hedge ...............................................................................</td>
</tr>
<tr>
<td>5.5</td>
<td>Floating rate &amp; swap combination ......................................................................</td>
</tr>
<tr>
<td>5.6</td>
<td>Floating rate &amp; cap combination .......................................................................</td>
</tr>
<tr>
<td>6</td>
<td>Analysis and recommendations ..........................................................................</td>
</tr>
<tr>
<td>6.1</td>
<td>Commencing words ...............................................................................................</td>
</tr>
<tr>
<td>6.2</td>
<td>Summary ...............................................................................................................</td>
</tr>
<tr>
<td>6.3</td>
<td>Recommendations for action ..............................................................................</td>
</tr>
<tr>
<td>7</td>
<td>Concluding remarks .............................................................................................</td>
</tr>
<tr>
<td>7.1</td>
<td>Conclusions ..........................................................................................................</td>
</tr>
<tr>
<td>7.2</td>
<td>Discussion .............................................................................................................</td>
</tr>
<tr>
<td>7.3</td>
<td>Further research .................................................................................................</td>
</tr>
<tr>
<td>8</td>
<td>References .............................................................................................................</td>
</tr>
</tbody>
</table>

Appendix ........................................................................................................... i
List of Tables

Table 1. Projected LTV ratios in Europe Q1 2017 - Q2 2018. ........................................13
Table 2. Real estate net operational CF. ........................................................................34
Table 3. Input data. ........................................................................................................35
Table 4. Descriptive statistics fixed rate loan. ............................................................41
Table 5. Descriptive statistics floating rate loan. ..........................................................41
Table 6. Descriptive statistics swap. ..............................................................................42
Table 7. Descriptive statistics floating & cap. .................................................................42
Table 8. Summary comparisons. ..................................................................................44

List of Figures

Figure 1. 3M EURIBOR Historical interest rates. .........................................................3
Figure 2. Research design. ............................................................................................5
Figure 3. Forms of real estate .......................................................................................6
Figure 4. Forms of investments ....................................................................................7
Figure 5. Direct and indirect investments. ....................................................................9
Figure 6. Type of investors ..........................................................................................10
Figure 7. Overview derivatives ...................................................................................15
Figure 8. Gross market value OTC derivatives. ..........................................................16
Figure 9. Interest rate contracts by instrument ............................................................17
Figure 10. Illustration swap ........................................................................................18
Figure 11. Citation fact sheet interest rate swaps ......................................................19
Figure 12. Profit or loss options ..................................................................................22
Figure 13. Profit or loss options. ................................................................................22
Figure 14. Analyzed scenarios ....................................................................................31
Figure 15. 100 out of 10,000 interest rate simulations ..............................................40
Figure 16. Average simulated interest rates per year .................................................40
Figure 17. Distribution of ROEs, fixed vs. floating .....................................................46
Figure 18. Distribution of ROEs, fixed vs. swap .......................................................47
Figure 19. Distribution of ROEs, floating vs. swap ....................................................48
1 Introduction

The purpose of the first chapter is to introduce the concept of real estate investment by using debt finance from an investors point of view. It will be further narrowed down to the problem(s) for the company and how this thesis will contribute to solving them.

1.1 Background

The Norwegian sovereign wealth fund is the largest sovereign wealth fund in the world. It invests the revenues from Norway’s oil and gas production in stocks, bonds and real estate (Fouche, 2017). In April 2016, the wealth fund announced to raise its real estate allocation, both listed and unlisted, from five to seven percent (IPE Real Estate, 2016). By the end of 2016, the fund owned a portfolio of property investment worth of $21.9 billion in cities such as New York, London, Paris, Berlin, and Munich (Fouche, 2017). Yngve Slyngstad, Chief Executive of Norges Bank Investment Management, which manages the ever-growing Norwegian fund, said in the beginning of this year: „We buy (...) properties, in good locations, that we think will be worth a whole lot more 30 years from now” (IPE Real Estate, 2017).

As can be seen from the above-mentioned quote, real estate is usually a long-term investment. In order to acquiesce a real estate, a loan from a financial institution due to high investment costs is normally necessary. Interest rates may greatly influence the number of potential buyers. When banks charge low interest rates, the number of real estate buyers generally increases, since interest rate expenditures are lower (Kolbe, 2012). Due to the expansive monetary policy of the European Central Bank (ECB) and the Federal Reserve (FED) in the USA, interest rates are at all-time-low. They even have been turning negative. As a side note, in February 2015, Danish bank Nordea charged a client -0.0172 percent interest effectively paying interest to the borrower (Hakim & Eavis, 2015). In March 2017, the management of Norway’s $900-billion wealth fund said that property investments returns may not remain as high and stable in the future if interest rates start to rise (Fouche, 2017). Hence, low interest rates can work in favor of the investor, but increasing interest rates can jeopardize real estate investments.
The master thesis at hand investigates the investment in real estate with regards to financing and interest rate risk management from the investor’s point of view. To exemplify the authors’ approach, a case study is conducted. The underlying data come from a real-life real estate investor as well as a financial institution to make this study as realistic as possible.

1.2 Company and bank

The given data set is provided by a large German real estate investor. The project can be seen as a special purpose vehicle (“SPV”) only founded for the one property. Since there is no non-disclosure agreement in place, the authors refer to the investor throughout the thesis as “the investor”, “the company”, “the firm” or “the SPV”. The company manages multiple real estate funds consisting of a mid-three-digit number of properties in all sixteen German federal states and in the USA. The property types are a mixture of office, residential, commercial (e.g. supermarkets), special (e.g. hotels or warehouses) and apartments. The services include asset, property and fund management. The total assets value amounts to more than €700 million (Lubnau, 2017).

The data for real life interest rates, fixed loans, and margins are provided from a large German bank. The financial institution is a major player in real estate finance and interest rate hedging markets. More than 2,500 employees work in multiple offices in Germany as well as abroad. The balance sheet amounts to approximately €100 billion. The relevant contact person works within the Capital Markets department as Senior Executive Sales Real Estate pricing hedging instruments on a regular basis and is therefore also familiar with the pricing of loans. The provided rates and margins were only priced for the purpose of this master thesis taking into account the given information (e.g. location) from the authors.

1.3 Problem discussion

Real estate investors are exposed to numerous kinds of risks. There is the business risk, in which changes from original projections in expenditures and property values etc. appear. The management risk when a real estate is not properly managed. This can lead to legal risks, in cases when tenants feel unjustly treated and seek to defend themselves in court (Goddard & Marcum, 2012). And then there is the above-mentioned market price risk of interest rates. Since debt financing is a common type of real estate finance, the investor is constantly exposed to interest rate risk, when new deal opportunities arise (Kolbe, 2012). Changes in
interest rates are unpredictable since the underlying market parameters are inconstant (Parkin, 2005). Decisions on interest rate policy taken by the ECB or events such as the Brexit cause European interest rates to remain volatile as displayed in Figure 1.

![3M EURIBOR Historical interest rates](image_url)

**Figure 1.** 3M EURIBOR Historical interest rates. Source: Reuters, 2017.

Hence, the question for the company is: “How should one deal with volatile interest rates that could make the difference between failure and success in real estate investment?” The capital market offers several financial instruments (so-called “derivatives”) to overcome the above-mentioned obstacle. Unfortunately, there is no “one-size-fits-all” strategy. The kind of loan, as well as the financial interest rate management tools, depend on several factors such as the characteristics of the investment, the company’s knowledge/experiences, fulfillment of regulatory requirements, liquidity, risk appetite and so on. When used not in a speculative way, derivatives are powerful instruments to avoid future losses, create cash-flow (CF) stability and ensure the success of the real estate deal. The question remains which financing structure to combine with which form of derivative.

### 1.4 Purpose and research questions

The purpose of this master thesis is to analyse and investigate if real estate investors can benefit from different financing plans and hedging strategies with respect to both risk and return. To achieve this purpose, the ratio return on equity (ROE) and return cash-flows at
risk (CFaR, based on CF simulations affected by changing Euro interest rates) are conducted. The authors will also derive recommendations of action. To further investigate, three specific questions shall be asked:

- How can a superior financing strategy look like?
- How can a superior hedging strategy look like?
- How does a sale of the property (before loan maturity) affect the returns and CFs?

The underlying case study of the thesis is a quantitative assessment (of 10,000 CF simulations within each scenario), which strategy/strategies is/are favorable for the real estate investor.

1.5 Delimitation

A comprehensive understanding of real estate, financing strategies, derivatives on interest rates as well as the linkage between those three segments is crucial to find and present meaningful results. Because there is nearly an infinite number of different combinations, the authors decided to focus on sixteen scenarios\(^1\), which are separated into two segments (the company keeps the real estate or sells it at the end of year five) using the following restrictions:

- Residential real estate (due to the given data set)
- Two financing (loan) strategies applying two different debt and equity ratios
- Two hedging instruments

Since the acquisition of a property as well as the financing and risk management are three separate contracts, the whole project will be divided within the theoretical framework of this study and merged in the empirical part. The effectiveness of the chosen financing and hedging strategies will be evaluated and compared to each other to obtain conclusions and provide guidance for the company. For simplicity reasons, the authors disregard taxes.

1.6 Disposition

This master thesis is divided into seven sections as indicated in Figure 2. Within the first chapter, the topic of real estate finance and hedging is introduced by discussing the problem of the investor. Purpose and research questions, as well as delimitations, follow. The second

\(^1\) The specific scenarios are displayed in the methodology.
part, the theoretical framework, gives an overview of the three main segments of this thesis: investing in real estate, financing and interest rate risk management. This chapters’ main purpose is to show the theoretical toolbox necessary to make the most of what follows. Part number three summarizes relevant previous conducted research. The methodology in chapter four aims to provide the reader on the one hand with an understanding of the chosen research methods and on the other hand with a numerical introduction to the conducted CF analysis. The empirical findings shall be presented in chapter five. From the investors perspective, the following chapter six is the heart of the thesis. The findings will be analyzed, compared to each other and concrete recommendations of action will be derived. The above-stated research questions will be answered. Lastly, in part seven, concluding remarks summarizing the results, as well as a discussion and possible further research, will be provided.

Figure 2. Research design. Source: the authors’ own compilation.

2 Theoretical framework

The second chapter presents and explains the relevant theoretical framework necessary to provide the reader with in-depth knowledge about real estate (investment), financing and hedging.

2.1 Forms of real estate

Two broad forms of real estate are commercial real estate and residential real estate. Residential real estate includes all sorts of houses that are meant to accommodate people and are available for non-business purposes. Commercial real estate is intended for business purposes.
As Figure 3 shows, residential real estate can be further broken down into single-family and multi-family homes. A single-family home is a house that has direct access to a street and does not share heating facilities or hot water equipment with other homes. Multi-family homes consist of multiple separate housing units that are contained within one building. In urbanized areas, multi-family homes are the predominant type of residential real estate as expensive land costs can be divided over more units. The demand for residential real estate is more stable than the demand for commercial real estate, because private individuals need shelter, regardless of the economic situation (Brueggeman & Fisher, 2010). It can therefore be concluded that residential real estate is less cyclical than commercial real estate.

Commercial real estate includes but is not limited to, office, retail, industrial, and hotel. As commercial real estate is considered riskier than residential real estate, returns that investors require are often higher. Real estate assets that comprise multiple tenants are considered a safer investment than assets that comprises only one tenant as bankruptcy or lease termination of one tenant in a multitenant office building can be compensated by the other tenants. Other important factors that affect the risks are the location, state of repair, and the type of real estate. Hotels for instance, are in general considered riskier than supermarket buildings.
2.2 Investing in real estate

2.2.1 General aspects of real estate investments

Real estate is an asset class that differs substantially from other traditional asset classes such as bonds and stocks. Beside currencies and commodities, real estate is considered an alternative asset class as shown in Figure 4.

![Forms of investments](image)

*Figure 4. Forms of investments. Source: Adapted from Gibson, 2008.*

Each real estate asset is unique in its physical structure, geographic location, and tenant mix. Hence, each real estate investment opportunity should be evaluated individually – making the real estate market less efficient than the stock and bond market. This inefficiency creates opportunities for skilled investors, benefiting from acquiring undervalued properties (Gibson, 2008). However, inefficiency also leads to illiquidity; the disposition of a single real estate asset can easily take more than six months. Real estate investment returns are derived from rental income and from capital gain. Due to the rental income, real estate investments typically provide a steady CF, especially when a real estate asset comprises multiple tenants as bankruptcy or lease termination of one tenant can be compromised by the other tenants (Geltner & Miller, 2006).

The diversification benefit of real estate is an important reason why investors include multiple asset classes in their mixed-asset portfolio. The Modern Portfolio Theory suggests that investors can increase their returns for a given level of risk by including assets in a portfolio that are not perfectly positively correlated with one another. As the correlation between the different asset classes moves closer to zero, the diversification benefit increases (Markowitz, 1952). This is one of the main reasons why the Norwegian sovereign wealth fund invests in stocks, bonds, and real estate.
Furthermore, most rental contracts enable landlords to increase the rental rates during periods of inflation. Real estate is therefore widely used by investors as a protection against inflation. It should be addressed though, that this does not hold true if the real estate investment is highly financed with a floating-rate-loan since elevated inflation usually forces banks to increase interest rates accordingly (Brueggeman & Fisher, 2010).

Another characteristic of real estate investments is the high transaction costs. Whilst it is relatively cheap to buy and sell stocks and bonds, transaction costs in real estate are usually within the five to ten percent range of the asset price, depending on the property type, size, and country. Real estate transaction costs typically consist of transfer tax, legal fees, agency fees, and registration costs. In general, higher transaction costs make real estate markets more illiquid as it is more costly to enter the market (Geltner & Miller, 2006).

### 2.2.2 Direct and indirect investing in real estate

When investing in real estate, one can either acquire an interest in a property or in an entity. Investing in property is known as investing directly whereas acquiring an interest in an entity or fund is known as investing indirectly. Both approaches have their advantages and disadvantages.

When an investor invests directly in a property, he is responsible for the operation of the asset. The investor could decide to outsource the operation to a property manager. One of the advantages of investing directly as supposed to indirectly is having more control in decision-making. However, the amount of money needed makes it for many investors impossible to invest directly. To acquire a shopping mall, for instance, a large amount of equity is needed. Other downsides of investing directly are the high transaction costs, the illiquidity, and the inability to diversify if the investment sum is relatively low.

Investing indirectly typically involves buying shares of institutional investors. By investing indirectly, also less wealthy investors that seek to invest a small amount are able to benefit from a well-diversified real estate portfolio. The transaction costs of investing indirectly are much lower than those of investing directly. Furthermore, the shares of indirect real estate investments can be sold much faster than an actual real estate asset, making it a more liquid investment strategy (Glickman, 2014).
Investing indirectly is often performed by investing in real estate investment trusts (REITs). REITs are companies that own or finance real estate. On one hand, REITs are required by law to pay out 90% of the earnings in dividends. On the other hand, REITs benefit from favorable tax legislation. Although numerous REITs were founded in Europe, Asia, and Australia, most REITs are based in the U.S. REITs were officially implemented in France in 2003 and in Germany and the U.K. in 2007. Most REITs are publicly traded. (Brueggeman & Fisher, 2010).

![Figure 5. Direct and indirect investments. Source: Adapted from Glickman, 2014.](image)

### 2.2.3 Types of investors

A fundamental assumption of finance is that low-risk levels are associated with low return and high-risk levels with high return. Some investors are very conservative and thus not willing to accept much volatility in their investment. Conservative investors typically invest a greater proportion in bonds than in stocks, both because of their investment strategy and regulations. Investors that are taking more risk require a higher return on their investment. Investors’ attitude toward risk is not only reflected in the asset classes they invest in, but also in the way they hedge against uncertainties such as exchange rate risk and interest rate risk. It can therefore be concluded that there is no “one-size-fits-all” strategy to compose an investment portfolio or to hedge against uncertainties. The right strategy highly depends on the investor’s risk profile. “Real estate investors” can be broken down into several subcategories as indicated in Figure 6 (Glickman, 2014).
Two broad categories of investors are institutional investors and non-institutional investors. Institutional investors are larger organizations, for instance, pension funds, mutual funds, or investments banks. Institutional investors owned 67% of the New York Stock Exchange stocks in 2010 (Blume & Keim, 2012). All other investors are non-institutional investors. Examples are private individuals who invest to save for their retirement or enterprises that seek a return on excess cash.

Pension funds and insurance companies typically invest their funds to meet their future financial obligations. CF matching, matching future inflow and outflow of cash, is a portfolio strategy used pension funds and insurance companies to meet their future financial obligations. By investing in long-term mortgage capital, future inflow and outflow of cash can be accurately matched as the receivable amounts are better predictable than with investing directly in real estate. Yet, pension funds and insurance companies also invest directly in real estate as it yields higher returns than investing in long-term mortgage capital. Pension funds and insurance companies are typically risk averse.

The Norwegian wealth fund, mentioned in the introduction, is an example of a sovereign wealth fund. In general, these funds are risk averse (Glickman, 2014).

Investment banks and Private Equity firms are more risk tolerant than the previously mentioned investors. Investment banks are specialized in providing financial related and other services to individuals, governments, and institutional investors such as pension funds.
Private Equity firms are firms that typically seek to acquire property, add value through active management and favorable market developments, and then sell the property at a profit.

2.3 Financing real estate

2.3.1 Real estate as collateral
Unlike stocks and bonds, real estate can be pledged as collateral when an investor is obtaining a loan. If the borrower fails to meet its financial obligations toward the lender, the collateral can - after a legal process - be claimed by the lender (McGee, 2015). The risk of loss to the lender is lower if the collateral is pledged; therefore, interest rates on loans that are collateralized are lower than those that are not. Hence, real estate investors can borrow cheaper than investors that are not able to pledge collateral (Cummings, 2008).

2.3.2 Financing real estate: the financier's perspective
Not only banks provide loans to real estate investors, but also private lenders, insurance companies, and pension funds. Financiers provide loans to real estate investors to obtain interest rate payments whilst managing credit risk. Financiers use numerous measures to assess credit risk.

The LTV ratio is an important determinant of the credit risk that is widely used by banks. The following formula can be used to calculate the LTV ratio (Cummings, 2008):

\[
LTV\ ratio = \frac{Loan\ Amount}{Property\ Value}
\]

If 60% of a real estate investment is financed, the lender is fairly certain that it will receive most of its debits. If a borrower is in default, the lender can foreclose on the property and sell it to recover the full amount of the loan, even if the market value of the property drops by 30%. This holds not true though, when the LTV ratio is closer to 100%.

Basel III\textsuperscript{2} requires banking organization to assign a risk weight of 150%\textsuperscript{3} to any high-volatility commercial real estate loans. However, if the LTV ratio of the loan is 80% or lower, the

\textsuperscript{2} Basel III: Regulatory framework designed to strengthen the regulation, supervision and risk management of the banking sector.

\textsuperscript{3} Risk weight: according to Basel III, each bank has a maximum asset exposure, which depends on its equity levels. The higher the risk weight of a loan, the more in contributes to reaching the maximum.
assigned risk weight of the loan can be lower than 150%; the risk weight then depends on other factors and ranges between 100% and 150%. Banks can provide more loans when the overall assigned risk weight is lower, contributing to the profitability. It is therefore favorable for banks to keep LTV ratios of real estate loans below 80% (Ernst & Young LLP, 2013).

Another measure used by banks to assess risk is the debt service coverage ratio (DCR) which is calculated by the following formula (Geltner & Miller, 2006):

\[
DCR = \frac{\text{annual net operating income}}{\text{annual debt service}}
\]

(Equation 2)

The net operating income is derived from rental income minus costs and the debt service includes interest rate and principal payments. The DCR indicates the ability of the borrower to cover the loan payments with the CF that is generated from the property.

Third, the credit worthiness of an investor is another important factor lenders look into before they decide to grant a loan. Lenders typically require that a credit report be obtained on borrowers. Most credit reports contain a rating that indicates the likelihood that a prospective borrower will fail to repay a loan during a specified period. The poorer the credit worthiness the higher the interest (or the loan request will be rejected altogether) (Brueggeman & Fisher, 2010).

2.3.3 Financing real estate: the investor’s perspective

There can be several reasons why investors utilize debt to finance real estate acquisitions. Firstly, it could be the case that an investor seeks to buy a property for which it does not have sufficient equity. Another reason could be that an investor has enough equity but decides to borrow anyway so that multiple properties can be acquired. Investing equity in multiple properties on different geographic locations, rather than investing in one building, mitigates the overall risk by diversifying. The third reason for using debt is to realize higher ROEs. This process is commonly known as financial leverage and only leads to higher ROE if the return on capital (ROC) exceeds the interest rate on debt. As achieving a high ROE is important for many investors, the capital structure of a real estate deal is an aspect that should be considered (Brueggeman & Fisher, 2010). An example, which can be found in the
appendix, illustrates the impact of financial leverage on the ROE. Please note that this example is highly simplified and that key aspects such as corporate tax is left out.

2.3.4 Terms and conditions of a loan

There are many types of loans that can be used to finance the purchase of real estate such as mortgage-backed loans, bridge loans, and construction loans. This thesis focuses on mortgage-backed loans, commonly known as mortgages. When this type of loan is obtained by an investor, real estate is pledged by the borrower as collateral. The terms and conditions vary from case to case. The lender and borrower typically negotiate the nominal amount, interest rate, maturity, and repayment (Glickman, 2014).

2.3.4.1 Nominal amount

The nominal amount is the amount originally borrowed minus the any principal paid. The maximal nominal amount that real estate lenders are willing to offer depends, among other factors, on the value of the collateral real estate. As indicated in Table 1, KPMG predicted the average LTV ratio for commercial real estate in Germany, Italy, the UK, and Spain to range between 53% to 72% in the period Q1 2017-Q2 2018 (KPMG, 2016).

<table>
<thead>
<tr>
<th></th>
<th>Germany</th>
<th>U.K.</th>
<th>Spain</th>
<th>Italy</th>
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<tr>
<td>Office</td>
<td>72%</td>
<td>70%</td>
<td>60%</td>
<td>55%</td>
</tr>
<tr>
<td>Retail</td>
<td>72%</td>
<td>70%</td>
<td>55%</td>
<td>60%</td>
</tr>
<tr>
<td>Industrial</td>
<td>65%</td>
<td>68%</td>
<td>53%</td>
<td>60%</td>
</tr>
<tr>
<td>Hotel</td>
<td>60%</td>
<td>68%</td>
<td>58%</td>
<td>60%</td>
</tr>
</tbody>
</table>

Table 1. Projected LTV ratios in Europe Q1 2017 - Q2 2018. Source: Adapted from KPMG, 2016.

2.3.4.2 Interest rate

The interest rate that lenders require depends on several aspects. In principle, the interest rate that a bank requires consists of two components: the risk-free rate and the risk premium (Geltner & Miller, 2006).

The risk-free rate is a theoretical rate of an investment with zero risk. Generally, an increased demand for money on the money market leads to higher a risk-free rate and in turn to higher interest rates. The average interest rate at which banks of a country or a group of countries offer to lend unsecured funds to other banks is considered a proxy for the risk-free rate on loans. The Euro InterBank Offered Rate (EURIBOR) is the most common proxy for the risk-free rate used by Eurozone banks (Bodie, Kane, & Marcus, 2014). In section 2.4, the EURIBOR will be further explained. There are several ways how the future EURIBOR can be estimated. In banking, analyzing the yield curve is the most common method to predict
interest rate movements. The yield curve shows the interest rate of bonds with the same credit quality, but with different maturities. If the interest rate increases with the bonds’ maturity, the yield curve is considered to be “normal”. However, if bonds with a longer horizon pay lower interest rates than short-term bonds, interest rates are likely to drop. In finance, this is called an “Inverted Yield Curve”, which considered a predictor of economic recessions (Bodie, Kane, & Marcus, 2014).

In addition to the risk-free rate, the risk premium is a component that affects the interest rate banks require. Higher levels of credit risk are associated with higher risk premiums. Various measures are used by banks to assess credit risks such as the LTV ratio, DCR and the borrower’s credit worthiness (Cummings, 2008).

2.4 Risk Management

2.4.1 Derivatives and hedging

Derivative securities, or simply derivatives, are financial instruments that play a significant role in financial markets (Bodie, Kane, & Marcus, 2014). These securities’ prices are “derived from” the prices of other assets or underlyings, such as interest rates, stocks, commodities etc. as indicated in Figure 7 (U.S. Securities and Exchange Commission, 2000). Thus, since the derivatives payoff depends on the value of those securities, they can be a powerful tool for both speculation and hedging (Bodie, Kane, & Marcus, 2014). The term hedging refers to the usage of derivatives to reduce the market risk that hedgers face from potential future movements in for example the above-mentioned asset classes (Hull, 2011). In order to correctly apply this financial risk management strategy, an investor takes the equal and opposite position in the desired market to protect one’s capital from rising or falling prices (Black, Hashimzade, & Myles, 2012).

2.4.2 Markets

Derivatives can be traded either via exchanges or over-the-counter (OTC) as shown in Figure 7. Due to the technological development, the open outcry system, where traders physically meet on trading floors, shout and agree on prices, are increasingly replaced by electronic trading systems allowing for the growth of algorithmic trading (e.g. high-frequency trading)

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4 The authors of the thesis solely focus on the hedging purpose of derivatives. Nevertheless, the third group besides speculators and hedgers are arbitrageurs, who aim to lock in a riskless profit.
(Hull, 2011). The world’s leading marketplace is the Chicago Mercantile Exchange Group, handling more than three billion contracts annually.

![Diagram of derivative financial market](image)

**Figure 7.** Overview derivatives. Source: U.S. Securities and Exchange Commission, 2000.

The over-the-counter trades are negotiated between the involved parties (e.g. via phone) and, since there is no standardized exchange involved booked by the counterparties themselves. Due to the free negotiation, OTC market offers the advantage of financial contracts tailored to the client needs (Ruffini & Steigerwald, 2014). Hence, the cost of establishing an OTC contract (e.g. swaps or options) are higher than for exchange traded derivatives (Bodie, Kane, & Marcus, 2014).

Irrespective of exchange traded or OTC, liquidity is key to any derivatives trade (Bloss, Ernst, Häcker, & Eil, 2009). On the one side, lower market volatility often leads to increased liquidity, as market makers require less spread to cover unexpected market moves (tighter bid-offer spreads\(^5\)). On the other side, higher market volatility often leads to decreased liquidity, as market makers require more spread to cover unexpected market moves (wider bid-offer spreads). If a (derivatives) market is illiquid, potential buying or selling problems may arise, leading to capital losses (Jewitt, 2015).

### 2.4.3 Market size

Every half a year, the Bank for International Settlements (BIS) collects statistics regarding the market size of OTC derivatives.\(^6\) The BIS is the world’s oldest international financial organization based in Basel, Switzerland. The 60-member central banks together account for

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\(^5\) Bid-offer spreads refer to the difference between the highest price a buyer is willing to pay for an asset and the lowest price a seller is willing to sell.

\(^6\) According to the BIS, the exchange traded derivatives market is comparably small compared to the OTC derivatives market. Therefore, the authors focus on statistics regarding OTC traded derivatives.
about 95% of the world’s GDP. BIS’ mission is to serve central banks in their pursuit of monetary and financial stability (Bank for International Settlements, 2017). According to the end-June 2016 statistics, the gross market value of OTC derivatives amounts to $19.2 trillion (Figure 8). The gross market value represents the sum of the fair values (or CF obligations) of the outstanding contracts between the involved parties (Bank for International Settlements, 2016). The risk segment interest rate has been accounting constantly the highest share of the gross market value. In June 2016, it accounts for approximately 80 percent indicating that it is the most liquid derivative market.7

2.5 Instruments

The world of derivatives offers dozens of possible hedging strategies. Therefore, this thesis will focus on hedging strategies, which are relevant for the company’s CF analysis/simulation. That is also why different hedging strategies (in terms of quantity or amount of underlyings) such as rolling hedges etc. will be disregarded since these strategies rather apply to commodity companies.

Figure 8. Gross market value OTC derivatives. Source: Adapted from BIS, 2016.

2.5.1 Forwards and future contracts

A forward is a non-standardized private agreement to buy or sell an asset at a predefined future time for a predefined price with usually one specific delivery date. Normally, the involved parties are two banks or a financial institution and one of its clients. When one party

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7 In this case, the gross market value is used as a derivatives market size measurement, since it takes into account the overall cost replacing the contracts at current market prices. It is possible to report the notional amount outstanding of all derivatives, but such a number does not take into account bilateral netting (long and short positions net each other out; also see chapter XX).
agrees to buy the underlying asset, it assumes a long position. The other party (e.g. a financial institution) agrees to sell the asset and assumes to hold a short position. A forward can be contrasted with a spot contract, such that the delivery time is not in the future, but today.

Parties interested in entering exchange markets, rather than OTC markets, sign future contracts. Futures are standardized agreements between two parties to buy or sell an asset at a predefined time for a predefined price with usually a range of delivery dates.

### 2.5.2 Swaps

One of the most important hedging instruments are swaps (Hull, 2011). Within the risk class interest rate, 89% of the gross market value comes from these instruments (Bank for International Settlements, 2016).

Swaps are OTC agreements between two parties to exchange or “swap” future CFs. In contrast to forward contracts, in which CFs are exchanged only once, swaps typically include the exchanges of CFs on numerous future dates. The calculation of the CFs from a swap involves the future value of the relevant underlying – in the company’s case an interest rate (Hull, 2011). Other underlings can be for instance currencies, commodities or equities (Ankarath, Mehta, Ghosh, & Alkafaji, 2010). Also, the bank offering the swap agreement can but does not necessarily have to be the same financial institution which offers the loan.

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8 The chapter „Swaps“ will provide a deepening of this topic.
9 Since this thesis focuses on OTC derivatives, futures will neither be further explained nor regarded.
In a “plain vanilla”\(^{10}\) interest rate swap, a company agrees to pay CFs equal to interest at a predefined fixed rate calculated on a notional principal\(^{11}\) for a predefined time horizon. By the same token, the company receives interest CFs at a floating rate calculated on the same notional principal for the identical period of time (Kwok, 2013). Figure 10 illustrates the function of an interest swap agreement.

![Figure 10. Illustration swap. Source: Adapted from Finnerty, 2013.](image)

When the bank loan is on a floating basis, a swap can switch the variable (unknown) future interest obligations to fixed (known) interest payments inevitably leading to CF stabilization. The derivative’s floating rate receivable is designed to cancel out the loan’s floating rate payable, since both benchmarks (3M EURIBOR) within the loan as well as in the swap are identical (Finnerty, 2013). This refers to the elimination of basis risk, which occurs when the benchmarks are not the same (e.g. 3M EURIBOR vs. 6M EURIBOR) (Coyle, 2001). The company becomes the so-called fixed-rate payer of the swap rate (here 4%). By contrast, the financial institution becomes the floating rate payer (here 3M EURIBOR) (Anson, Fabozzi, Choudhry, & Chen, 2004). Effectively, the company pays the swap rate of 4% and the 1% credit margin resulting in 5% interest in total. Now, this financial risk is hedged and a possible rise in interest rates cannot jeopardize the company’s project anymore (Finnerty, 2013).

In case of the company, the floating rate is the 3M EURIBOR. It is a rate at which prime banks lend each other (interbank) funds in euro. The maturities vary from one week up to twelve months and the rate is calculated daily (European Central Bank, 2017). Presently, 20 banks from ten different European countries contribute to the EURIBOR for example Deutsche Bank, BNP Paribas, and UniCredit (European Money Markets Institute, 2017).

Generally, banks act as market makers for swaps. These financial institutions enter into a swap agreement sometimes without having an offsetting swap (hedge) with another

\(^{10}\) This in the financial industry used term describes the simplest form of a financial instrument.

\(^{11}\) The notional principal is a hypothetical underlying quantity needed for computation of the CFs.
counterparty. Thus, market makers need to quantify and hedge (e.g. by bonds or interest rate futures) their own exposure (Hull, 2011). To cover its costs, the bank will charge its customer a margin, which is incorporated in the swap rate (Madura, 2014).

At maturity, the swap’s value will be zero. Nevertheless, during the life time of a swap, its value can be either positive or negative (Anson, 2008). Also, it is reasonable to assume that the value of a swap is zero when entered into the agreement (Hull, 2011). At $t=0$ the deal is a fair bargain for both parties, since the present values of both discounted swap payments are exactly equal (Anson, 2008). If this case does not hold, arbitrage opportunities could arise (Bodie, Kane, & Marcus, 2014). However, in practice, this has proven to be wrong. On 22 March 2016, the German Federal Court of Justice (“Bundesgerichtshof”) ruled that financial institutions have to point out negative market values (from the client’s perspective) of swaps on the date of transaction due to serious conflict of interests. A municipality of North-Rhine Westphalia sued the German WestLB for wrong investment advice in three interest rate swap cases (Bundesgerichtshof, 2016).

Throughout the world, several similar lawsuits have been filed after the financial crisis of 2008. Therefore, financial institutions for instance like Danske Bank adjusted their fact sheets on interest rate swaps with the shown citation (Figure 11) (Danske Bank, 2016).

Since a swap can be traded via phone and due to the fact that is a private transaction, a legal written agreement called confirmation is needed. It is signed by representatives of both parties (Hull, 2011).

There are no payments at the transaction date of a swap. At the end of the settlement period (usually after one or three months), the payments will be computed and netted by the

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12 Arbitrage refers to exploiting pricing inefficiencies or abnormalities to earn profit without taking any risks.
calculation agent (typically the bank) leading to one payment (cash settlement) from one party to another (Calamos, 2003). The payment is determined by the three-months EURIBOR rate. The CF of a fixed rate payer (and a floating rate receiver) at the end of each settlement period depending on the day count convention will be (Brooks & Chance, 2012):

\[
(\text{Notional amount}) \times (3M \text{ EURIBOR} - \text{ fixed rate}) \times \left(\frac{\text{days}}{360 \text{ or } 365}\right)
\]  \hspace{1cm} (Equation 3)

In case the company sells the real estate and pays back the loan prematurely, the company is considered to be over-hedged, because the notional amount of the hedge exceeds the notional amount of the loan (now €0). This could lead to payments from the company to the bank in case the three months EURIBOR settles below the swap rate of 4% (Schwartz & Smith, 1990). Therefore, the firm must terminate or “close out” the swap leading to a compensating amount/unwind value at which the parties are willing to give up the swap agreement (Moles, 1997). This so-called mark-to-market value will be positive (negative) if the swap agreement has a positive (negative) market value resulting in a net payment to the company (the bank) (O’Kane, 2008).

In summary, the industry views the benefits and the risks of an interest rate swaps as follows (see appendix for an overview): On the one hand, an interest rate swap eliminates the risk of rising interest rates by introducing a fixed rate (instead of a floating rate). This leads to certainty since the interest payment becomes predictable for the whole duration (reliably meet CF requirements) (Westpac Banking Corporation, 2016).

Furthermore, a swap is flexible. It is an independent deal of the loan contract meaning the interest rate risk can be managed without amending the financing contract. The firm can manage the interest rate exposure by adjusting the principal amount, the payment periods as well as the contract duration (Raiffeisen Bank, u.d.). The costs of an interest rate swap are inherent in the swap rate. Hence, no upfront payment (establishment fee, transaction fee or monthly service fees) is required (Westpac Banking Corporation, 2016).

On the other hand, the company cannot take advantage of any favorable (falling) interest rate movements, since the rate is locked-in (Raiffeisen Bank, u.d.). Also, in the case of early termination (if the real estate is sold), the firm may step out of the hedge, but depending on
the market value of the swap there can be additional expenses. Moreover, the company faces the counterparty risk, in case the bank cannot meet its obligations (Hypovereinsbank, 2013). Lastly, the firm needs to be able to handle operational risk (e.g. valuation, hedge accounting).

2.5.3 Options

As can be seen from Figure 9 above, options account for nine percent of the gross market value within the risk class interest rate (Bank for International Settlements, 2016).

Options differ fundamentally from forwards and future contracts. As mentioned above, the parties in a forward or future contract have agreed with one another to deliver (e.g. a stock). By contrast, an option gives the option holder the right to exercise, but he or she is not forced to do so. In addition, the purchase of an option requires an up-front payment – the option premium.

2.5.3.1 Types and positions

Generally speaking, two basic types of options exist. A call option gives the option holder the possibility to buy a certain asset at a predefined future time for a predefined price. A put option gives the holder the right to sell an asset at a predefined future time for a predefined price. The price at which the option can be used is known as exercise price or strike price (K). The specified date is called expiration date or maturity date. Another type character of options is their exercising point of time. American options can be used at any time until the expiration date. By contrast, European options can be used only on the maturity date.

There are two positions to every option contract. On the one hand, an investor can take a long position meaning he bought the option and becomes the option holder. On the other hand, an investor can take a short position meaning he sold the option and becomes the option writer. The option writer collects the premium up front but faces potential liabilities later. The option’s seller profit or loss corresponds in reverse to the profit or loss of the option holder (Hull, 2011). The four different types of option positions (left) and the relevant payoffs (right) can be found in Figure 12 and 13. The premium costs are not included in the payoff diagrams. As stated above, K represents the strike price and ST is the final price of the underlying asset. The charts ignore discounting so that the profit equals the final payoff minus the option cost.
Due to their shape, option payoffs are also called hockey sticks (Bruner, 2004). A term describing the relationship between the strike price of an option and the current trading price of its underlying asset is called Moneyness. Options can either be in the money, at the money or out of the money (Khouw & Guthner, 2016). A call option is said to be in the money, when $S> K$, at the money when $S= K$ and out of the money $S< K$. Conversely, a put option is in the money when $S< K$, at the money when $S= K$ and out of the money when $S> K$. The holder of a call option will exercise when it is in the money. Undoubtedly, an option holder will make use of his right only when the option is in the money. If transaction costs are disregarded, in the money options will always be exercised (Hull, 2011). Not exercised options will expire with zero value (Brooks & Chance, 2012).

The payoff $\max(S_0-K, 0)$, where $S_0$ is the current underlying price, is referred to the intrinsic value of an (in the money) option if it was exercised immediately. The intrinsic value is zero for at the money and out of the money options. The difference between the actual call price and the option’s intrinsic value is called time value. The time value refers to the options value if it were to expire immediately. Hence, an at the moment out of the money call option is not necessarily valueless, since there is always a chance the underlying price will increase until the expiration date (Bodie, Kane, & Marcus, 2014).
An option holder can close out his position by selling the same amount of options. Reversely, the writer of an option can buy the same number of options (Kevin, 2009).

### 2.5.3.2 Cap\(^\text{14}\)

Building on the previous chapter, a (long) call is often referred to as a cap. When the 3M EURIBOR S exceeds the specified ceiling (cap) K, an interest rate cap offers payments (Madura, 2014).

The industry views the benefits and the risks of an interest rate cap as follows (see appendix A3 for an overview): A cap eliminates the risk of rising interest rates only above the call level. Therefore, and in contrast to a swap, the company could fully participate in decreasing interest rates (Hypovereinsbank, 2013). This leads to certainty since the maximum interest payment becomes predictable for the whole duration.

The benefit of full participation has its cost – namely the option premium. Usually, it has to be paid upfront to the bank and it is non-refundable (Westpac Banking Corporation, 2015). Depending on the chosen strike level, it is possible that the firm will never exercise the cap if interest rates do not exceed K.\(^\text{15}\) Hence, it can be seen as an insurance against rising interest rates (Hypovereinsbank, 2013). Since options are more volatile than swaps, operational risk has to be emphasized even more (Batten & Wagner, 2012).

### 2.5.4 Abstract regulation and critical review of derivatives

Warren Buffet, also known as the “Oracle of Omaha” is one of the most successful investors of all time and CEO of Berkshire Hathaway (Gandel, 2014). In Buffets annual letter to shareholders in 2003, he called derivatives “financial weapons of mass destruction” and he predicted that derivatives “will almost certainly multiply in variety and number until some event makes their toxicity clear” (Buffet, 2004). The failure of the fourth biggest investment bank in the USA, Lehman Brothers Holdings Inc. may have been the disaster he imagined (Goldstein & Henry, 2008). When Lehman Brothers filed for chapter eleven bankruptcy on 15 September 2008, the investment bank had 1.2 million derivative contracts with approximately 8,000 different companies in place. The net gross market value amounted to

\(^{13}\) Since the close out of options is more relevant to the firm than a possible early exercise, the authors disregard the latter.

\(^{14}\) Benefits and risks which equal those from a swap are not mentioned again.

\(^{15}\) It is worth noticing that interest rates above the swap level are possible as well if the strike prices are chosen to be higher than the swap rate.
$75 billion (McDonald O., 2015). If the derivatives market value of the bank is compared
with the 2015 GDP of countries, Lehman would have been ranked no. 67 out of 188
countries (International Monetary Fund, 2017) (McDonald O., 2015).

The political environment overestimated the power of market self-regulation and throughout
the world, governments and markets were caught by surprise of the waves of the financial
market crisis in 2008 that plunged the world into recession (Bundesministerium der
Finanzen, 2014) (Mehta & Wilkinson, 2016). In Germany, October 2008, laws were passed
in record time allowing for government guarantees of €400 billion and government equity
participation of €80 billion. A serious derivatives market regulation was not in place
(Bundesministerium der Finanzen, 2014).

As a response to the financial crisis of 2008, the leaders of the Group of Twenty (G20)
nations agreed to reforms in Pittsburgh, USA 2009 to increase the transparency of the OTC
derivatives markets in order to reduce systematic risk (Ernst & Young, 2015):

- **MiFID I/ II/ MiFIR: Markets in Financial Instruments Directive/Regulation:**
  - organized trading takes place on regulated platforms
  - rules on algorithmic and high-frequency trading
  - enhancing investor protection
    - MiFID I in place since November 2007
    - MiFID II/ MiFIR scheduled for 3 January 2018

(European Securities and Markets Authority, 2017)

- **EMIR: European Market Infrastructure Regulation:**
  - Enhancing transparency: reporting requirements, ESMA surveils
  - Mitigating credit risk: obligation to clear through central clearing counterparties
    (including collateral to be posted)
  - Reducing operational risk: using electronic means to promptly confirm the terms
    of OTC contracts
    - became effective on 2012 with constant implementation throughout the last
      years

(Bundesanstalt für Finanzdienstleistungsaufsicht, 2017) (European Commission, u.d.)
Especially EMIR tackles some of the above described typical OTC derivatives risks (e.g. counterparty and operational risk). Comparable measures were taken in the US by the U.S. Securities and Exchange Commission (SEC) by passing the US Dodd-Frank Wall Street Reform and Consumer Protection Act (effective 2010) (U.S. Securities and Exchange Commission, 2015). Hence, in order to trade OTC derivatives, the firm needs to sign many papers such as master agreements, credit support annex, EMIR documents, power of attorney and so on (Bundesverband Deutscher Banken, u.d.). This leads to additional effort for the financial institutions as well as increased costs for the development of state of the art company risk management. Nevertheless, if regulation measures such as described above had existed in 2008, the central clearing house will have had accounted for the resulted losses (using the posted collateral) of companies (Dengl, 2013). Back then, the political environment used taxpayer’s money for (bank) bailouts which are considered to be controversial from an ethical and socio-economic point of view (The Economist, 2013).
3 Previous studies

The third chapter summarizes relevant previous research conducted on real estate finance, leverage, capital structure, hedging and Monte Carlo simulations.

Is there a superior real estate financing strategy? As stated in the theoretical framework, there is no one size fits all financing strategy. Studies on this topic seek, not to find one ideal financing strategy, but to study what factors investors consider when determining a suitable financing strategy. It should be noted that in this thesis, a mid-sized taxable company is examined.

According to Morri & Cristanziani (2009), the capital structure maintained by property companies depends on several variables. Firstly, the study demonstrates that companies’ asset size is positively correlated to companies’ leverage ratio, which is due to lower borrowing costs for bigger companies. This result is in line with that of Chikolwa (2011) who examined the determinants of capital structure of 34 Australian REITs from 2003 to 2008 and concluded that the larger companies are more leveraged than smaller companies. Secondly, Morri & Cristanziani argue that high operating risks are associated with low leverage ratios. The authors believe that this is due to the fact that managers of riskier firms try to reduce the overall uncertainty by adopting a rather conservative capital structure. Lastly, the authors argue that non-REITs are more leveraged than REITs because of their favorable tax regulations. The latter conclusion can be explained by a study that demonstrated that leveraging real estate leads, for nontaxable investors, to a decreased portfolio efficiency, but for taxable investors to an improved portfolio performance (Boyd, Ziobrowski, Ziobrowski, & Cheng, 1998).

McDonald (1999) concluded from his study that leverage adds value if borrowers have optimistic expectations about the real estate market. However, he also argues that more leverage increases the probability of default. This can be a reason why some investors choose to obtain low debt levels despite the fact that higher debt levels can lead to higher ROE.

In contrast to McDonald’s view on the possibility to add value by leveraging, the Modigliani-Miller Theorem (1958) states that capital structure is irrelevant to the value of an organization
or asset. The authors argue that the overall cost of capital cannot be reduced by substituting equity for debt. Adding more debt to a firm or asset increases the risk of an investment and in turn causing the expected return on equity to increase. The gain from the difference between borrowing costs and return on capital is offset by the increased expected return on equity. This theory disregards tax policies (Modigliani & Miller, 1958).

Is there a “superior financing strategy”? Harkins, Rathbone, & Phelan (2015) believe that choosing the right interest rate hedging strategy involves a tradeoff between flexibility and cost. They assert that a swap is the most flexible hedging strategy. Lambert & Burnand (2001) support this and argue that swaps, unlike fixed interest rate loan agreements, can usually promptly be removed from a loan. This suggests that the swap could form a suitable hedging product for investors who cannot rule out the disposition of the respective property in the near future. Fabozzi, Shiller, & Tunaru (2009) believe that the balance guarantee swap is a suitable derivative to hedge against interest rates movements.

Scholars have been testing and valuing various interest rate hedging instruments with different methods for decades. Harkins, Rathbone, & Phelan (2015) presented a case study in which several interest rate hedging instruments for real estate are compared. Three interest rate scenario’s - upward rate, downward rate, and forward rate - were used to quantify the instruments’ performance. This method demonstrates the power of different hedging instruments; however, it does not indicate the likelihood of each scenario. Hence, expected returns cannot be calculated. In order to evaluate different interest rate derivatives more accurately, methods such as Monte Carlo simulations, Hull-White tree procedures, or closed form solutions are typically used (Treepongkaruna & Gray, 2003). The authors studied how these three approaches can be used to price interest rate caps. They assert that Monte Carlo simulating is robust in generating distributions of future interest rates and in valuing interest rate derivatives. Furthermore, the study demonstrates through an example that the three methods lead to the same cap value as long as their future interest rate distribution matches with one another. The study of Treepongkaruna & Gray also shows that these methods can be used for other purposes in real estate. Jararaman (2013) confirms this by demonstrating how Monte Carlo simulations can be used to analyze real estate investments and to price mortgages.
It can be concluded that the ideal financing and hedging strategy depends on the investor’s perspective with respect to flexibility, liquidity, risk tolerance, and taxability. Moreover, according to previous research, interest rate simulations can be used to assess real estate investment projects, which is further elaborated in the following chapters.
4 Methodology

This chapter presents a summary of the research approach and methods used in this thesis. All sixteen scenarios are displayed as well as an overview of the input data and assumptions within the analysis is given.

4.1 Research approach and method

There are two methods of reasoning for the research approach: deductive and inductive. The deductive approach is often referred to as the ”top-down” approach and is focused on hypothesis testing. Typically, deductive research starts with the analysis of a theory, which is then tested through a hypothesis. The inductive approach, also known as the “bottom up” approach, is the opposite of the deductive approach. The aim of the inductive approach is to develop general conclusions or theories. It starts with observations, which are used to formulate the hypothesis. Then the hypotheses are explored and finally, general conclusions can be drawn (Saunders, Lewis, & Thornhill, 2009). As stated in the introduction, the purpose of this master thesis is to draw general conclusions on different financing plans and hedging strategies. Hence, the authors use the inductive approach.

In business research, quantitative and qualitative methods can be used. Both methods have different data collection techniques as well as data analysis procedures. Quantitative methods are used to quantitatively measure research problems by generating numerical data and to measure data to formulate facts, whereas qualitative methods are used to get an understanding of underlying reasons and motivations. In this thesis, different financing plans and hedging strategies are examined. Financing plans and hedging strategies have a numerical characteristic. Therefore, quantitative methods are used to perform the research.

A research design outlines how the investigation will take place. It describes how data is collected, what instruments will be used, and how conclusions can be drawn from the collected data (Cooper & Schindler, 2014). As stated in the previous section, this thesis employs the quantitative methods: case study and Monte Carlo simulation.

4.1.1 Case study

A case study is the research of one or several particular events, organizations, situations, or persons. A case study is considered from a specified perspective and with a special interest. Each case is unique, yet, related to something general. They are typically used for purposes
of demonstration and learning (Scholz & Tietje, 2002). Case studies can be both qualitative and quantitative. In this thesis, one case is examined and quantitative data is collected and analyzed.

As stated in the introduction, the authors of the thesis examine how real estate investors can benefit from different financing plans and interest rate hedging strategies. The company provided the authors with CF projections of an existing real estate investment project. The data comprises the purchase price, renovation costs, and other net CFs, which are derived from rental income minus operating expenses over a ten-year period. In order to perform the study, the authors incorporated different financing plans and hedging strategies in the provided CF projections. In total, four financing/hedging strategies are analyzed: a floating rate loan (no hedge), a fixed rate loan, a floating rate loan & swap combination and a floating rate loan & cap combination. These are real estate financing standard approaches. Furthermore, two capital structures are included: a LTV ratio of 40%, a rather conservative approach, and a LTV ratio and of 70%, an opportunistic, yet realistic approach. LTV ratios far outside the 40%-70% range are not common in the real estate investment industry and are therefore not included in this study. Finally, real estate investment firms can be forced to sell a property before the end of the intended investment horizon. For instance, as a result of liquidity problems or adverse market conditions. Therefore, an unexpected sale scenario at the end of year five is included for every hedging strategy and both LTV ratios. In total, sixteen strategies/scenarios are included in the analysis (Figure 14).
For each strategy with a floating interest rate component, 10,000 CFs are computed. Each CF has the same real estate CFs (rental income, operating expenses, renovation cost), but different interest rate expenses, which are based on Monte Carlo simulated interest rates. This way, not only the expected ROE per strategy/scenario is calculated, but also the 5% return CFaR and the volatility of the expected return on equity; all measures that could help investment managers to choose a strategy that matches their overall strategy and risk profile.

The authors have decided to perform the study through a quantitative case study for three main reasons:

- a case study makes it possible to examine how certain strategies perform in the real world, making it possible to draw practical conclusions.
- Interest rate hedging instruments are complex products. By simulating interest rates within the different scenarios, the authors introduce an artificial backtesting process to measure the effectiveness of the financing and hedging strategies after five and ten years. The interpretation of the results is comprehensive.
- The authors chose the case study approach, to draw general conclusions, which can also be meaningful for other (real estate) investment projects.
4.1.2 Monte Carlo simulation

In finance, the term Monte Carlo is associated with the process of simulating a system that is affected by randomness. Monte Carlo simulations are used to model the probability of different outcomes that are difficult to predict because of the intervention of random variables. Monte Carlo simulations are often used to simplify overly complicated problems that cannot be solved with a closed-form solution. Typical applications of Monte Carlo simulations include the pricing of derivatives, the computation of the expected payoff of an investment project, and calculation of the value at risk of a portfolio (Nawalkha, Soto, & Belieava, 2005). In this thesis, Monte Carlo simulation is used to simulate future interest rates movements for a ten year period (one interest rate per year so ten rates per simulation). These rates are then used to measure the performance of interest rate hedging and financing strategies for real estate investments.

A question that often arises regarding Monte Carlo simulation is: ”how many simulations are necessary?” A higher number of simulations are more time consuming but also more accurate. When Monte Carlo simulations are used in finance, for instance to price derivatives, the number of simulations typically ranges between 1,000 and 1,000,000, depending on the number of variables and the distribution type. Variance reduction techniques can substantially improve the accuracy and/or reduce the time needed to run a given number of simulations. Anti-thetic sampling is a widely used variance reduction technique which is known for its simplicity. The randomness in ordinary Monte Carlo simulations leads to error cancellation. Anti-thetic sampling seeks to increase the error cancellation by taking the “opposite” sample of Monte Carlo simulations. If the simulations are normal distributed, an anti-thetic sample can be generated by multiplying the Monte Carlo simulations by –1 (Owen, 2013). In this thesis, 100,000 interest rates are simulated to generate 10,000 interest rate movements (each interest rate movement consist of ten interest rates).¹⁶

In order to simulate interest rates with real-world interest rate characteristics, models should incorporate mean reversion, a drift, and volatility. Mean reversion refers to a process, in which interest rates tend to move toward the long-term average. Low interest rates tend to

¹⁶The most time-consuming part was not to simulate the interest rates but to calculate the ROEs with those interest rates. Variance reduction techniques were not necessary, as 10,000 interest rate movements were simulated rather quickly. A higher number of simulated interest rates would have made the calculation of the ROEs too time-consuming.
Boost the demand for capital, causing the rates to increase. On the contrary, high interest rates tend to slow down the economy leading to a decreased capital demand and causing the interest rate to decrease. Furthermore, the drift in interest rate models indicates the speed of the reversion. If the drift is larger, the interest rate tends to go back to the mean faster. Lastly, since real-world interest rates move randomly to some extent, interest rate models should include a volatility component. Interest rate models typically incorporate volatility through a normal or chi-square distribution (Baz & Chacko, 2009).

Three well-known interest rate models are the Vasicek model, the Cox-Ingersoll-Ross model (CIR model), and the Hull-White model. All models include the characteristics listed above; however, there are some substantial differences as well. The Vasicek model was developed in 1977 and is one of the first models that incorporated mean reversion. This model is the most concise model of the three models and it does not rule out negative interest rates. The simulated interest rates are normally distributed. The CIR model is similar to the Vasicek model; however, there are some key differences. The CIR model rules out negative interest rates. Furthermore, the CIR model involves a chi-square distribution. The parameters in the Vasicek and the CIR model are not time dependent. Therefore, is it difficult to fit the model closely to the yield curve to at a given time, which can be important to price options or measure duration. The Hull-White model is also similar to the Vasicek model but the mean in the Hull-white model is a deterministic function of time, making it the most suitable model to price derivatives (Baz & Chacko, 2009).

The authors of the thesis have decided to use the Vasicek model for two reasons. First, it does not rule out negative interest rates. Negative interest rates have been occurring in the market since 2015 (e.g. 3M EURIBOR rate) and are therefore needed in the simulation. Secondly, the Hull-White model introduces a deterministic function of time, which is redundant when the model is used to simulate interest rates (Nawalkha, Soto, & Belieava, 2005). Hence, the Vasicek model is the most concise approach for this kind of analysis.
The Vasicek model uses the following equation to simulate interest rates:

\[ dr_t = a(b-r_t)dt + \sigma dW_t \] (Equation 4)

Where:
- \( a \): speed of reversion
- \( b \): long-term mean level
- \( \sigma \): volatility
- \( W_t \): Wiener process (continuous-time stochastic process, normally distributed)

Before the Vasicek model can be used, the model should be calibrated, meaning the parameters \( a, b, \) and \( \sigma \) should be determined by using historical interest rates. 3M EURIBOR rates are used as historical values to calibrate the model. The calibration of the Vasicek model is conducted with Excel (Solver function) in accordance with the book *Handbook of Financial Risk Management* by Chan & Wong (2013).

### 4.2 Data collection and data input

The data sources used within the excel analysis can be separated into three segments:

- real life real estate CF values and premature termination fees from the company;
- historical 3M EURIBOR interest rates and bond rates from Thomson Reuters Eikon;
- real life interest rates for floating and fixed loans as well as margins from the above described German only priced for the purpose of this master thesis.

As can be seen in Table 2, the first ten-year CFs are stable and only vary slightly around approximately €2.5 million and €2.7 million:

<table>
<thead>
<tr>
<th>Year calendar</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2023</th>
<th>2024</th>
<th>2025</th>
<th>2026</th>
<th>2027</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year number</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Net operational cash flow (million)</td>
<td>€ 2.50</td>
<td>€ 2.54</td>
<td>€ 2.54</td>
<td>€ 2.53</td>
<td>€ 2.59</td>
<td>€ 2.70</td>
<td>€ 2.71</td>
<td>€ 2.70</td>
<td>€ 2.69</td>
<td>€ 2.69</td>
</tr>
</tbody>
</table>
The input values are summarized in Table 3.

Table 3. Input data. Source: the authors' own compilation.

<table>
<thead>
<tr>
<th>Real estate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Start date</td>
<td>2018-01-02</td>
</tr>
<tr>
<td>Exit discount factor</td>
<td>8%</td>
</tr>
<tr>
<td>Purchasing price</td>
<td>€ 32,871,385.99</td>
</tr>
<tr>
<td>Transaction cost</td>
<td>€ 2,629,710.88</td>
</tr>
<tr>
<td>Operational income 2023</td>
<td>€ 2,704,481.36</td>
</tr>
<tr>
<td>Operational income 2028</td>
<td>€ 2,878,466.26</td>
</tr>
<tr>
<td>Terminal value 2023</td>
<td>€ 33,806,016.95</td>
</tr>
<tr>
<td>Terminal value 2028</td>
<td>€ 35,980,828.19</td>
</tr>
<tr>
<td>Renovation cost 2030</td>
<td>€ 7,500,000.00</td>
</tr>
</tbody>
</table>

Loan values (forward starting)

| Date of pricing | 2017-04-26 |
| Start date loan | 2018-01-02 |
| Amortization period | 30 years |
| Loan period | 10 years |
| Premature termination fee fixed loan (% of debt amount * year) | 0.88% |
| Premature termination fee floating loan (% of debt amount * year) | 0.10% |

Rates per instrument

<table>
<thead>
<tr>
<th>40 LTV level</th>
<th>70 LTV level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equity amount</td>
<td>€ 19,722,831.59</td>
</tr>
<tr>
<td>Debt amount</td>
<td>€ 13,148,554.40</td>
</tr>
<tr>
<td>10Y 3M EURIBOR</td>
<td>0.865%</td>
</tr>
<tr>
<td>Risk premium &amp; margin</td>
<td>1.50%</td>
</tr>
<tr>
<td>Fixed interest rate</td>
<td>2.365%</td>
</tr>
<tr>
<td>Floating margin</td>
<td>0.15%</td>
</tr>
<tr>
<td>Risk premium &amp; margin</td>
<td>1.50%</td>
</tr>
<tr>
<td>Floating interest rate (excluding EURIBOR rate)</td>
<td>1.65%</td>
</tr>
<tr>
<td>10Y 3M EURIBOR</td>
<td>0.865%</td>
</tr>
<tr>
<td>Risk premium</td>
<td>1.50%</td>
</tr>
<tr>
<td>Floating margin</td>
<td>0.15%</td>
</tr>
<tr>
<td>Swap margin</td>
<td>0.15%</td>
</tr>
<tr>
<td>Floating &amp; swap combination</td>
<td>2.665%</td>
</tr>
<tr>
<td>Risk premium</td>
<td>1.50%</td>
</tr>
<tr>
<td>Floating margin</td>
<td>0.15%</td>
</tr>
<tr>
<td>Floating &amp; cap combination (lowest rate, if EURIBOR &lt;0)</td>
<td>1.650%</td>
</tr>
<tr>
<td>Strike</td>
<td>2.00%</td>
</tr>
<tr>
<td>Floating &amp; cap combination (maximum rate)</td>
<td>3.650%</td>
</tr>
<tr>
<td>Debt amount</td>
<td>€ 13,148,554.40</td>
</tr>
<tr>
<td>Margin cap premium</td>
<td>3.42%</td>
</tr>
<tr>
<td>Cap premium</td>
<td>€ 449,036.28</td>
</tr>
</tbody>
</table>

Red font indicates values regarding the selling scenario, in which further information are needed. The analysis' start date is chosen to be the second of January 2018 due to bank holiday one day earlier. Hence, from the perspective of a real estate investor in 2017, a forward starting loan is needed meaning the values are priced on 26th April 2017, but
effectively start in 2018. The transaction cost for the acquisition amount to eight percent of the purchasing price and will be paid by equity. The capitalized CF is the CF from the relevant year (2023 or 2028) divided by the discount factor (perpetuity). This represents the value of the building at the end of the loan period. In other words, it is the terminal value, which needs to be adjusted for the renovation cost in 2030.

The principal payments to the bank are computed using an amortization period of 30 years, although the first loan period only has a market standard maturity of ten years. The respective notional amounts of the hedges decrease according to the principal payments of the loans. In case the investor sells the property at the end of year five, termination fees are needed. The floating fee is lower due to rolling three months refinancing strategy of the bank itself (Lubnau, 2017). According to the bank, the margin for a swap as well as a floating rate loan is 0.15% or 15 basis points (bp). The bank adds an extra margin for the floating rate loan because it offers the client the possibility to repay the loan prematurely (on a three months basis). These values are considered under the below mentioned LTV scenarios. The 10Y 3M EURIBOR rate starting January 2018 of 0.865% was interpolated by the authors using 10Y 3M EURIBOR forward rates starting in six months (end of October 0.828) and nine months (end of January 0.883) respectively to obtain the needed eight months’ forward value.

The residential property close to a German metropolis can serve as collateral on the loan amount since it is already fully built there is no completion risk and rental agreements are in place. According to the financial institution and since the financing will be within a SPV, the credit rating can be seen as A minus, which is an upper medium grade. Two LTV ratios are chosen. The 40 LTV level starts with a risk premium of 1.5%17. The following bullet points exemplify how the relevant rates are computed for the 40 LTV level:

- Fixed interest rate = 2.365%:
  1.5% risk premium + 0.865% 10Y 3M EURIBOR.

- Floating interest rate (no hedge) = 1.65%:
  1.5% risk premium + 0.15% floating margin.

---

17 Critically reviewed, this estimation is trustworthy. According to Reuters, non-governmental bonds with ten years' maturity and an A rating, which is slightly better than A minus, showed yields of 1.331 on the date of pricing.
• Floating/swap = 2.665%:
  1.5% risk premium + 0.865% 10Y 3M EURIBOR + 0.15% floating margin + 0.15% swap margin.

• Floating/cap = 3.65%:
  1.5% risk premium + 0.15% floating margin + 2% strike.

To put these numbers in perspective it should be noted that 2.365% and 2.665% are fixed rates. 1.65% is the starting rate for the floating interest loan and subject to change depending on the 3M EURIBOR simulation. 3.65% is the maximum rate for the floating & cap combination. Lower rates are possible due to the optional character of the hedging instrument depending on the simulation. The minimum rate is therefore 1.65% (1.5% risk premium + 0.15% floating margin). The total upfront premium for an out-of-the-money cap amounts to nearly €450,000 and is due in T₀.¹⁸

If the company wishes to leverage the investment more, a 70 LTV ratio can be selected. All above-shown rates are 0.2% points higher for that case, due to the change from the risk premium from 1.5% to 1.7%. The premium costs in bp are not subject to change regardless of the notional. Nevertheless, the overall cap cost increase to approximately €785,000 due to the higher notional.

4.3 Assumptions within the analysis

In order to correctly interpret CF analysis, assumptions regarding the quality of the data need to be made. The authors cross-checked the given information on margins and interest rates as far as possible with banks, Thomson Reuters and the supervisor of this thesis. The real estate data had not undergone such handling. Hence, the authors see those values as “correct” without any questioning. Also, the values are viewed as stable and do not perform a “what-if-analysis” on for instance unexpected renovation costs or increase/decrease of the property value.

The fluctuating interest rate in year one is assumed to be -0.33%, which is the last relevant 3M EURIBOR spot value from 31 March 2017. For simplicity reasons, the authors assume the interest rates only to change once a year. Moreover, the loan is assumed to be “floored”

¹⁸ The authors decided to implement an out-of-the-money cap due to fewer premium costs compared to lower strike levels.
at zero. One the one hand, this means that the client does not participate from negative interest rates. Hence, the bank will not pay the company a fee or interest for the loan. On the other hand, the client does not pay -0.33% to the bank resulting from the floating lag either. If the 3M EURIBOR simulation settles below zero, zero is therefore assumed.

The principal amounts are computed using the “goal seek” function in excel taking into consideration the amortization period. The total payments to the bank (sum of principal plus interest) in a fixed rate loan are assumed to be constant over the financing period. The interest rate payment to the bank depending on the strategy is:

\[ \text{Total outstanding debt} \times \text{simulated 3M EURIBOR rate or swap rate or fixed rate} \]

(Equation 5)

After every year, the principal amount paid back by the company to the financial institution reduces the total debt of the company. The principal payments within the floating structure (including hedges) are assumed to be identical as in the fixed scenario for the 40- and 70-LTV ratios. This will provide a common ground for comparison in the analysis and interpretation of the empirical findings. Nevertheless, due to the higher debt amount in the 70 LTV scenario, the principal amount increases. The total payments to the bank regarding the swap are higher due to the relatively higher swap rate/interest rate payments.

In the cases, where the company decides to sell the property, the simulation stops after five years and the terminal value of 2023 instead of 2028 is seen as the selling prices of the property with which the company repays the loan and the early termination fee of the bank prematurely. In this case, the company must sell the hedge back to the financial institution (since the underlying loan is not in place anymore). The authors are aware of the fact that the swap will have a positive or negative market value and the cap most likely will have a non-negative market value leading to another CF. But since the value of the hedge depends on the unknown 3M EURIBOR interest rate forward curve at the selling time point, the authors assume the market value to be zero. Hence, the positive CF from the bank to the company will be disregarded. Nevertheless, since the swap is a separate contract, the company could keep the hedge and use it for another real estate project with an underlying floating loan.
5 Empirical findings

This chapter presents a summary of the interest rate simulations and CF calculations using descriptive statistics within forms of aggregated tables. These values also build the foundation for the analysis and interpretation of real estate financing and hedging.

5.1 Risk factor

This thesis deals with the most important market risk of rising interest rates. This risk has been introduced and identified in the theoretical framework. The methodology chapter above showed how this thesis aims to quantify the interest rate risk. The results of this quantification shall be presented in the following chapters. As a matter of fact, it should be kept in mind that the interest rate is a variable component in the financing structure. When this variable position is not “closed” with a suitable hedging instrument (or a fixed rate loan) and interest rates rise during the loan (or amortization) period, the profitability of the project can decrease significantly or even lead to liquidity shortage. Consequently, it is fundamental to exploit the possibilities derivatives can offer from a risk management perspective to attain a predictable result/forecast CFs. If the financing structure remains unhedged (and if the bank is actually willing to accept this “strategy”), then this is a matter of choice from the investor enduring this risk exposure throughout the relevant period.

5.2 3M EURIBOR simulation

The Vasicek approach was used to simulate future interest rate movements. 100 out of 10,000 simulations are graphically represented in Figure 15.

---

19 It should be mentioned that numerous other risks could be inherent in real estate investment (inflation, counterparty, foreign exchange etc.).
To obtain a better understanding of the ROE and return CFaR in the upcoming chapters, the following graphical summary of the above shown developments of the simulated 3M EURIBOR should be kept in mind:

Figure 16. Average simulated interest rates per year. Source: The authors’ own compilation.

As displayed in Figure 16, the interest rates start out to be negative but turn positive within year one. A constant interest rate increase due to the mean-reverting character of the Vasicek model can be observed up to approximately 2.5% at the end of the loan period.
5.3 Fixed rate

In a strategy, where the loan is fixed at 2.365% and 2.565% respectively (depending on the LTV level), no hedge is needed. All considered statistics are identical within the relevant scenarios, besides the standard deviation, which can be disregarded since there simply is none. The fixed rate loans within the 10Y maturity show the highest ROE. With respect to the 40 LTV level the ROE is 8.92% and with a 70 LTV level, it is 13.43%.

In the selling scenario, the returns are lower namely 5.02% and 6.22% respectively.

Table 4. Descriptive statistics fixed rate loan. Source: The authors’ own compilation.

<table>
<thead>
<tr>
<th></th>
<th>Fixed rate 10Y 40 LTV</th>
<th>Fixed rate 10Y 70 LTV</th>
<th>Fixed rate 5Y 40 LTV</th>
<th>Fixed rate 5Y 70 LTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>8.92%</td>
<td>13.43%</td>
<td>5.02%</td>
<td>6.22%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>5% return CFaR</td>
<td>8.92%</td>
<td>13.43%</td>
<td>5.02%</td>
<td>6.22%</td>
</tr>
<tr>
<td>95% potential</td>
<td>8.92%</td>
<td>13.43%</td>
<td>5.02%</td>
<td>6.22%</td>
</tr>
</tbody>
</table>

5.4 Floating rate without hedge

In the case of a floating rate loan structure without any particular interest rate hedging instrument, again the higher LTV ratio yields the highest average ROE (12.84% vs. 8.69%) within the no selling scenario. The 5% return CFaR and the 95% potential vary roughly 1.5% points around the average for the 10Y 40 LTV level. For the 10Y 70 LTV level, it is approximately 3% points to the 5% return CFaR and 2% points to the 95% potential. The SD is three times higher for the more leveraged scenario but still comparably low (0.51% and 1.59%).

In case the property will be sold in year five, the average ROE is still higher with more debt. The standard deviations are 0.53% and 1.8%. The 5% return CFaR for the 70 LTV level is dramatically lower than the average (1.01% versus 7.26%) and the absolute gap between the average ROE (7.26%) and the 95% potential (9.31%) is circa two percent points.

Table 5. Descriptive statistics floating rate loan. Source: The authors’ own compilation.

<table>
<thead>
<tr>
<th></th>
<th>Floating rate 10Y 40 LTV</th>
<th>Floating rate 10Y 70 LTV</th>
<th>Floating rate 5Y 40 LTV</th>
<th>Floating rate 5Y 70 LTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>8.69%</td>
<td>12.84%</td>
<td>5.33%</td>
<td>7.26%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.51%</td>
<td>1.59%</td>
<td>0.53%</td>
<td>1.80%</td>
</tr>
<tr>
<td>5% return CFaR</td>
<td>6.94%</td>
<td>7.31%</td>
<td>3.48%</td>
<td>1.01%</td>
</tr>
<tr>
<td>95% potential</td>
<td>9.39%</td>
<td>14.99%</td>
<td>5.94%</td>
<td>9.31%</td>
</tr>
</tbody>
</table>

5.5 Floating rate & swap combination

If the company is interested in combining a floating rate loan with a swap as an interest risk management tool, the swap rates are fixed at 2.665% and 2.865% respectively (depending on
the LTV level. All considered statistics are identical within the relevant scenarios, besides the standard deviation, which can be disregarded since there simply is none. In the no selling scenario, the higher debt structure leads to the highest ROE of 12.88% and the 40 LTV level yields 8.74% ROE.

In the selling scenario, the returns are lower namely 5.23% and 6.9% respectively.

Table 6. Descriptive statistics swap. Source: the authors’ own compilation.

<table>
<thead>
<tr>
<th></th>
<th>Swap 10Y 40 LTV</th>
<th>Swap 10Y 70 LTV</th>
<th>Swap 5Y 40 LTV</th>
<th>Swap 5Y 70 LTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>8.74%</td>
<td>12.88%</td>
<td>5.23%</td>
<td>6.90%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>5% return CFaR</td>
<td>8.74%</td>
<td>12.88%</td>
<td>5.23%</td>
<td>6.90%</td>
</tr>
<tr>
<td>95% potential</td>
<td>8.74%</td>
<td>12.88%</td>
<td>5.23%</td>
<td>6.90%</td>
</tr>
</tbody>
</table>

5.6 Floating rate & cap combination

If the real estate investor would like to combine a floating rate loan with a 2% cap as a hedging instrument, the average ROE is 11.87% for the 70 LTV level and 8.45% for the 40 LTV level respectively. The 5% return CFaR and 95% potential intervals lay close at the average for the lower debt level and vary approximately 1.5% points for the higher LTV ratio (10.29% vs. 11.87% vs. 13.63%). The risk parameter SD is higher in the higher leveraged case (0.31% versus 0.94%).

In case the investor sells the property at the end of year five, the average ROEs are 4.92% and 5.81% for the 40 LTV and 70 LTV level respectively. The SD is comparable to the no selling scenario. The 5% return CFaR and the 95% potential intervals are close to the average for the 40% level and vary roughly 1.5% points to 2% points from the average for the 70% financed case (3.87% vs. 5.81% vs. 7.33%).

Table 7. Descriptive statistics floating & cap. Source: the authors’ own compilation.

<table>
<thead>
<tr>
<th></th>
<th>Floating &amp; cap 10Y 40 LTV</th>
<th>Floating &amp; cap 10Y 70 LTV</th>
<th>Floating &amp; cap 5Y 40 LTV</th>
<th>Floating &amp; cap 5Y 70 LTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>8.45%</td>
<td>11.87%</td>
<td>4.92%</td>
<td>5.81%</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.31%</td>
<td>0.94%</td>
<td>0.33%</td>
<td>1.09%</td>
</tr>
<tr>
<td>5% return CFaR</td>
<td>7.95%</td>
<td>10.29%</td>
<td>4.32%</td>
<td>3.87%</td>
</tr>
<tr>
<td>95% potential</td>
<td>9.04%</td>
<td>13.63%</td>
<td>5.38%</td>
<td>7.33%</td>
</tr>
</tbody>
</table>
6 Analysis and recommendations

In this part of the thesis, an analysis of the different financing and hedging possibilities are presented. From there, the authors give recommendations for action for the real estate investor.

6.1 Commencing words

Throughout this thesis, the authors have been analyzing how derivatives can lead to stable CFs. The simulation shows a rise in the floating rate 3M EURIBOR during the financing period. When the investor is in fact convinced that interest rates will rise, a fixed rate or a hedging instrument need to be considered.

The selling scenarios are not planned scenarios. If the real estate investor, in fact, would consider selling the property at the end of year five, the company would neither enter into ten-year tenor loan contracts nor enter into ten-year hedging instruments in T0. The firm would choose tenors matching the point in time when the sale is planned. Hence, the selling scenarios are cases, in which the company is for instance “forced” to sell the property, because of possible liquidity shortages. In the following subchapters, the authors draw comparisons of the strategies focusing on ROEs. These ratios are set in context to CF predictability and flexibility leading to recommended actions.20

6.2 Summary

Primarily, it can be concluded that, besides the floating & cap combination, all ROEs increase with a higher a LTV ratio. Due to the low interest rate environment, leverage financing works. The empirical results have shown that the floating loan & cap combination is the least preferred structure to pick since all other average ROEs are higher than those of the floating loan & cap combination. Therefore, this scenario has not been under further investigation.

It is also noteworthy, that seven simulations caused an overall negative ROE. These cases solely come from the floating rate (without hedge) scenarios. A negative ROE does not necessarily mean default of the SPV since the investor could add more equity. However, it

20 The authors disregard a further discussion of the risk parameter standard deviation as the results are comparably low and stable across the scenarios.
certainly highlights the importance of interest rate hedging as a CF stabilization tool leading to favorable DCR.

It can be concluded that in the no selling scenario, the real estate investor generates the highest average ROE by entering into a fixed loan contract. Floating & swap combination and floating without a hedge follow. If the company is unexpectedly forced to liquidate the asset at the end of year five, the floating & swap combination is most advantageous for the firm. In that case, the floating loan structure would lead to higher average ROEs and offer more flexibility than a fixed rate loan. Table 8 summarizes the results of the comparisons for the ten-year and unexpected sale five-year scenarios including the different LTVs.

Table 8. Summary comparisons. Source: the authors’ own compilation.

6.2.1 Fixed vs. floating
Before the real estate investor digs to too deep into different hedging possibilities, the first step should be to decide whether a hedge is actually necessary. This can be achieved by investigating the performance of a fixed rate loan vs. a floating loan. The fixed rate loan was priced at 2.365% and 2.565%, whereas the floating rate loan starts at 1.65% and 1.85% respectively and fluctuates during the loan period.

The fixed rate loan is favorable for three reasons. Firstly, the fixed rate structure yields a higher average ROE in both scenarios (8.92% & 13.43% vs. 8.69% & 12.84%). Secondly, for both LTV levels, the 95% ROE potential for the floating loan is further away from the average ROE than the 5% return CFaR. For instance, in the 10Y 70 LTV case, the 95%
potential value of 14.99% is circa 2% points higher than the average (12.84%), but 7.31% is approximately 4.5% points below the average. This means a greater downside risk for the investor. Thirdly, although the floating structure starts at a lower rate than the fixed rate loan, due to rising interest rates within the simulation, this interest advantage will be lost over time. Choosing the floating structure would only lead to a higher average ROE if the 3M EURIBOR remains relatively low in the next ten years. Hence, the fixed rate loan is more beneficial for the (risk averse) investor from the ROE, return CFaR as well as from the CF predictability point of view throughout the financing period.

On the contrary, in the selling scenario, the floating loan yields a higher average ROE than the fixed rate loan. There are two reasons for this. Number one, the investor can benefit from the low (negative) interest rate environment in the first years, whereas the fixed rate loan is especially in the beginning of the period comparably more expensive. Reason number two is, that the early termination fee for the floating rate structure with ten bp is cheaper than the one of the fixed rate loan (85 bp). Moreover, the 5% return CFaR with 3.48% and 1.01% respectively for the floating rate loan, are lower than the average ROE for the fixed rate scenario. Hence, the risk averse real estate investor would even consider the fixed rate scenario in a selling scenario and prefer to pay the higher early termination fee, although the floating rate offers possibly, but without certainty, higher average ROEs.

Figure 17 displays the ROEs distribution for this comparison. The y-axis shows the number of simulations and the x-axis the ROEs in percentage.\textsuperscript{21} The ROEs for the fixed rate loans show exactly one value for all simulations. The floating rate loan ROEs are not normally distributed but left-skewed. The ROE-peaks for the 40 LTV simulations indicate that many ROEs are close to 6% (floating rate 5Y) and 9% (floating rate 10Y). The ROEs of the 70 LTV cases are more dispersed and peak approximately at 9.5% (floating rate 5Y) and 15% (floating rate 10Y).

\textsuperscript{21} The authors use this kind of graphs two more times in the following chapters and therefore do not introduce the y-axis and x-axis description again.
6.2.2 Fixed vs. floating & swap combination

Having proven that a fixed rate structure is, in fact, advantageous in both scenarios, the question whether or not the combination of a floating rate loan and swap might be even more suitable needs to be answered. The floating rate loan & swap combination was priced at 2.665% and 2.865% respectively. That is slightly higher than the fixed rate structure.

The hedging instrument with 8.74% shows a marginally lower average ROE compared to the fixed rate loan (8.92%). The same principle holds for the higher LTV ratio. The reason lays in the slightly higher swap rate, which includes a 30 bp add-on due to the floating and swap margins. Hence, the fixed rate loan is more beneficial for the (risk averse) investor from the ROE, return CFaR as well as from the CF predictability point of view.

In the selling scenario, a different picture emerges. The swap is a more favorable strategy than the fixed rate loan, although the swap rate, for both LTV ratios, is 30 bp higher. This emphasizes one important advantage of derivatives compared to fixed rate loans. Derivatives introduce flexibility to the project, since they are a separated contract. The investor can sell the hedge back to the bank at minimum cost. This is not possible for the fixed rate loan, which is bound to the project. The ROE of the fixed rate loan is lower due to a high early termination fee of 85 bp a bank would charge. Hence, if the company is forced to sell the property, the floating loan and swap structure is more flexible and therefore more beneficial for the firm than the fixed rate loan.
The floating rate loan & swap combination ROEs are shown as a dotted line. The ROEs for these loans show exactly one value for all simulations. The small gaps between the fixed rate loans and the floating rate loan & swap combination highlight the return similarity between these two instruments.

**Figure 18.** Distribution of ROEs, fixed vs. swap. Source: the authors’ own compilation

### 6.2.3 Floating vs. floating & swap combination

Since the swap rate is fixed, this comparison is comparable to the chapter “fixed vs. floating”. From the (average) ROE perspective, only the former fixed rate 8.92% changes to 8.74%. Therefore, there is no need in further investigating this scenario due to the marginal difference.

When the company is forced to sell the property, these two alternatives are almost equally good. Indeed, the floating rate loan offers slightly higher average ROE for both LTVs (5.33% & 7.26% vs. 5.23% & 6.9%). Nevertheless, there is also more risk inherent. For instance, the “risky” gap between the average ROE and the 5% return CFaR in the 70 LTV case is approximately 6% points (7.26% minus 1.01%). Whereas the “opportunistic” gap between average ROE and the 95% ROE potential is only 2% points (9.31% minus 7.26%). Thus return-wise, the downside risk is larger. The same applies to the 40 LTV case. Hence, a risk
inverse investor would “lock in” the secure CF from the floating & swap combination and create predictability. Since both loans are floating, the flexibility is given in both cases.

The graphical presentation of the instruments is comparable to that of the fixed vs. floating case since the floating rate loan & swap combinations replace the fixed rate loan in this comparison. Due to the above-mentioned similarity (return-wise), there will be no further investigation in the case at hand.

![Figure 19. Distribution of ROEs, floating vs. swap. Source: the authors’ own compilation.](image)

### 6.3 Recommendations for action

Building on the empirical findings and the comparisons, the authors of this thesis developed three concrete recommendations for action for the company.

Firstly, the results from the 3M EURIBOR simulation and the CF analysis have proven that the ROEs as well as the return CFaR increase when a higher debt financing level is applied. Thus, return-wise a 70 LTV level is more advantageous than a 40 LTV level. Given the low interest rate environment, this is plausible. If no internal guidelines indicate otherwise, the 70 LTV level should be chosen. Likewise, the financial institution will have a limit of lending money to the firm due to its own risk policy. Previous studies indicate that banks rarely exceed the 70 LTV level.²² If the company wishes to obtain more debt, other forms of

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²² If the LTV level is higher than 70, the question arises if the leverage effect, due to increased interest rate expenditures, is still given.
collateralization such as blocked money market deposits can be a possible remedy. The higher debt amount could, for instance, be used to cover the eight percent transaction costs of the purchasing price or the option premium. Hence, if the investor seeks to maximize profits, despite the increased risk, the company should choose a high LTV level and just in case of default select a limited liability organization form.

An increased amount of debt eventually leads to higher principal payments (unless the amortization period is prolonged), which leads the authors to the second recommendation for action - changes within the repayment structure. The assets projected net operational average CFs exceed the debt service. Even in the average return-wise least beneficial scenarios (floating rate loan & cap combination), most of the simulated net present value CF amount to approximately €500,000 in T_{10}. If the company does not intend to reinvest this free CF in other projects (or if it does not serve as collateral), it may be used to repay the loan earlier. This could, for instance, be done by making unscheduled repayments at the end of each year, depending on the free CF level and if it is possible under the loan contract. Usually, floating rate loans offer this possibility. Whereas fixed rate loans are less flexible in this regard. According to the performed simulation, the 3M EURIBOR will constantly rise throughout the financing period effectively increasing the investors’ interest rate expenditures. Hence, by repaying more of the loan in the first five years, the total debt amount decreases and the real estate investor could benefit to a greater extent from the low interest rate environment.

The third recommendation for action involves an actual hedging strategy. The 3M EURIBOR trades spot at -0.33% leading to a floating rate loan of 1.85% for a 70 LTV level. But when the investor chooses a fixed rate loan or a floating loan & swap combination, the interest rate to be paid starting in 2018 would be 2.565% or 2.865% respectively. Thus, the company directly pays 0.7% points or 1% point on top of the floating rate. The firm secures its CF throughout the next ten years, but in the near future, the investor cannot automatically benefit from the low interest rate environment. Therefore, the company could debt finance the project using a floating rate loan and for instance, implement a contractual clause. This clause could state if the 3M EURIBOR spot rate or the relevant forward curve exceeds a certain level, the investor is instantly obligated to buy a suitable swap from the bank. By doing this, the investor could further benefit from low (and further decreasing) interest rates and lock in a swap rate in the future. On the contrary, this strategy does not come without
disadvantages/risks. Firstly, the bank needs to agree to this term. Secondly, the moment the
3M EURIBOR rate increases, the forward curve most likely starts to steepen as well. In that
case, the rate of 2.865% might not be tradeable anymore and the investor would be obligated
to accept a higher yet unknown rate. Moreover, since the baseline scenario involves a
financing period of ten years without selling the property, this recommendation has to be
compared to a fixed rate loan of 2.565%. It should be stated, that the investor needs to fulfill
more regulatory requirements and allocate work capacity within the company when trading
derivatives. Thus, the investors’ (and the banks’) risk tolerance might be tested with this
recommendation for action.

If this proposal does not match the investor’s “risk appetite”, a more conservative approach
such as the fixed rate loan or a floating & swap combination might be more suitable. In case
the investor wishes to have an optional character, the financial institution could also structure
a swaption. With a long swaption, the company gains the right, but not the obligation, to
enter into a previously specified swap agreement on a future date. For this right, the firm
would need to pay an upfront premium.
7 Concluding remarks

In the last section, the research questions following the purpose of the thesis will be answered. Three main conclusions are drawn from the empirical findings and their analysis. The results and recommendations for action are discussed. Possible further research completes this master thesis.

7.1 Conclusions

The purpose of this master thesis is to analyse and investigate if real estate investors can benefit from different financing plans and hedging strategies with respect to both risk and return.

Research question number one: How can a superior financing strategy look like? Firstly, return-wise, the investor should strive toward a leveraged financing strategy as the 70 LTV level shows higher ROEs than 40 LTV level. This holds true for all scenarios besides floating & cap combination, which was ultimately disregarded due to the most unfavorable average ROE results. The most promising financing strategy is the fixed rate loan as it eliminates uncertainty and yields average ROEs of 8.92% (40 LTV) and 13.43% (70 LTV) respectively.

The floating loan without a hedge structure would offer more flexibility but yield lower average ROEs of 8.69% (40 LTV) and 12.84% (70 LTV). Since the standard case is the one in which the investor does not intend to sell, the lack of flexibility inherent in the fixed rate loan is negligible.

Research question number two: How can a superior hedging strategy look like? Seven simulations provide negative ROEs. The fact that all seven cases stem from the floating rate loan without a hedge structure highlights the necessity of stabilized future CFs for the investor as well as the financing bank. Thus, a fixed interest structure is inevitable for the investor.

Although not a hedging instrument per definition, the fixed rate loan offers protection against rising interest rates. If the investor solely focuses on the average ROE, the company should pick the fixed rate loan strategy over the floating & swap combination (8.92% & 13.43% vs. 8.74% & 12.88%). But, if the investor cannot rule out the possibility of selling
the property, then the floating/swap combination tips the scales flexibility-wise. Hence, the superior hedging strategy depends on the firm’s perspective.23

Research question number three: How does a sale of the property (before loan maturity) affect the returns and CFs? In that scenario, all average ROEs decrease substantially. The reasons are less operational income, a shorter time frame for leveraging, early terminations fees of the bank and the fact that the transactions costs can only be spread over five instead of ten years. The floating & swap strategy offers more flexibility than the fixed rate loan in dealing with the sale of the real estate yielding a higher average ROE of 5.23% and 6.9%.24

7.2 Discussion
Having obtained the main statements, these conclusions need to be put in wider perspective. The recommendation for striving for the higher leveraged financing strategy is in line with McDonald’s view stating that leverage can add value to real estate investors resulting in higher ROEs. On the contrary, Modigliani & Miller state that the choice of debt or equity is irrelevant, meaning leverage should not tip the scales. The results of this thesis correspond and mismatch Modigliani & Miller’s findings at the same time depending on the point of view.

In theory, as the project is a SPV, the CF level will determine the overall value of the vehicle. By obtaining an increased LTV level, higher CFs and ROEs are created. Hence, financing (the mixture of debt and equity) indeed matters. Nevertheless, it should be noted that the additional economic value can only be generated at the expense of increasing the risk parameter. Thus, from the perspective of the financial institution, the probability of default increases with a higher LTV level (from 1.5% to 1.7%), which is in line with McDonald’s view that more leverage increases the probability of default.

From an industry point of view, the theory cannot be confirmed. The financial institution – due to the quality of the SPV (high ranking, fully built etc.) – would finance this project with certainty. The bank does not face any substantial risk as even the higher debt amount lent would be fully covered by the collateralized real estate in case of default. Therefore, in this

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23 The swap outrivals its „hedging tool competitor“ cap return-wise and also avoids the additional financial burden accompanied by the upfront premium.
24 The floating rate loan yields the highest average ROE in the selling scenarios, but as shown in the analysis, it is also riskier than the floating & swap combination.
special case, the value of the property itself is more important than the default risk. Hence, from a practitioners point of view, the value added does not necessarily increase the risk parameter.

Hedging-wise, the results of the thesis are fully in line with the mentioned previous research from chapter three. The flexibility is given in the swap- as well as in the cap-strategies, but the costs associated with the option are in today’s low interest environment not justifiable. A cap would be a suitable instrument if the investor expects the interest rates to drop but he would like to insure himself at the strike level. The upfront premium in this case study does not amortize itself over the loan period. This in accordance with Harkins, Rathbone & Phelan who stated that the right interest rate hedging strategy involves a trade-off between flexibility and cost. Lambert & Burnand’s point of view is also matched in the selling scenario, as the floating & swap combination yields the highest average ROEs and also offers flexibility if the disposition of the real estate cannot be ruled out.

The possible ROEs and CFs of this investigation have proven that real estate investments can lead to attractive yields for the investor. Against this background, it is understandable that the Norwegian sovereign wealth fund planned to raise its real estate allocation in today’s low interest rate environment as it will most likely improve the portfolio performance of the fund. Generally, there is a strong move into real estate investment, since – due to the ECB’s quantitative easing – there are only a few bonds left with reasonable risk and return profiles.

With regards to the matter of rising interest rates, not only residential real estate investors, but also commercial real estate investors may find this case study insightful. The overall loan will not be fully repaid after the first financing period of ten years. Hence, rising interest rates represent a risk throughout the amortization period of 30 years for offices and hotels as well. By the same token, the interest rate risk is also a concern for banks as they need to refinance themselves as well when lending out loans. Investment banks, as issuers of mortgage-backed securities, belong to this circle as well.

From an ethical and socio-economic point of view, OTC derivatives are rightfully controversial. The financial crisis of 2008 might not have been fully avoided by a market regulation, but measures such as MiFID I/II / MiFIR and EMIR might have led to a less severe outcome. This is why this master thesis can be of interest for policy makers as well.
The results prove that hedging does not equal speculation.\textsuperscript{25} When done properly, hedging can increase the profitability of a project, introduce flexibility and increase CF stability in favor of the investor and the bank. In doing so, this could lead to less uncertainty within the investment and banking sector meaning possibly lower governmental bailouts financed by the taxpayer.

7.3 Further research
First and foremost, as mentioned above some assumptions were made within this analysis. The authors are aware of the fact that these assumptions reveal methodological and empirical weaknesses. A more sophisticated simulation approach, the inability to implement future hedging market values and the neglect of taxes are some examples. Nevertheless, the input data is derived from real life numbers, 16 different scenarios comprising thousands of CF computations and hands on recommendations for action were given.

Hence, further research could overcome these delimitations by introducing more LTV ratios, different points in time for selling, other loan structures (e.g. balloon) and possibly different hedging instruments approaches (e.g. other cap strikes) to obtain a more detailed insight. In addition, an analysis of 6M EURIBOR rates and hedging instruments fitting that variable rate may provide different results. Also, obtaining loans within US Dollar instead of Euros would expose the investor to currency risk, but also open up diversity opportunities from a portfolio perspective. In doing so, investors and banks from the USA could benefit from such an enhancement as well.

To simulate possible real estate bubbles, the given property data from the company could undergo a change. A steady increase in the property value of the real estate could, for instance, introduce such a scenario. A possible “what-if-analysis” including unexpected renovation costs or the implementation of inflation may provide a wider perspective. It should be noted that real estate is seen as a hedge against inflation since rising prices increase the (resale) value of the property. Given the ECB program of quantitative easing, when inflation rates rise above the ECB goal of two percent, the incorporation of this factor should be taken into consideration.

\textsuperscript{25} However, speculators may be needed to be counterparties for hedgers.
References


Appendix

A1 Leverage financing example
It can be seen from Figure below that in case A no debt is used so ROC equals ROE.

When analyzing case B, one can conclude that the income before taxes is $1.5 higher than case A. The additional $1.5 income before taxes is realized because the return on debt exceeds the interest rate on debt:
\[
\text{return on debt} - \text{cost of debt} = (\$ 150 \times 5\%) - (\$ 150 \times 4\%) = \$ 1.5
\]

Figure X shows that in case C, more financing is used than in case B, absolutely and relatively. Consequently, the LTV increases from 60% to 80%. Higher LTV levels lead to more risk for the financier and therefore to higher interest rates. In case C, the interest rate is higher than the ROC. As a result, the income before taxes drops from $5 in case A to $1 in case C. This can be explained with the following calculation:
\[
\text{return on debt} - \text{cost of debt} = (\$ 400 \times 5\%) - (\$ 400 \times 6\%) = -\$ 4
\]

It can be concluded that case B results in the highest income before taxes and the highest ROE. It should be addressed though, that case B is riskier than case A. The return on capital can turn out to be lower than budgeted – for instance, due to the bankruptcy of a tenant. Another uncertainty that the investor faces is the interest rate. Although the floating interest rate is 4% at first, the bank might increase the interest rate in the future as a response to market changes. There are numerous ways how investors can protect themselves against interest rate risk.

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A2 Benefits and risks of a swap

Benefits
- Elimination of interest rate risk
- Certainty
- Flexibility

Risks
- No participation in decreasing interest rates
- Early termination
- Counterparty & operational risk
A3 Benefits and risks of a cap

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<td>☐ No “value” of paid premium</td>
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<tr>
<td>☐ Flexibility</td>
<td>☐ Early termination</td>
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<tr>
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