Hedging multi-currency risk in CLO structures

NIBC

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Abbreviations

ABS	Asset Backed Security
CDO	Collateralised Debt Obligation
CDO^2	CDO squared
CDO^3	CDO cubed
CDS	Credit Default Swap
CLO	Collateralised Loan Obligation
CMBS	Commercial Mortgages backed security
CRA	Credit Rating Agency
Denom	Denominator
EUR	Euro
EURIBOR	Euro Interbank Offered Rate
FX	Foreign Exchange
FX rate	Foreign Exchange Rate
GBP	Great Britain Pound
IC	Interest Coverage
LIBOR	London Interbank Offered Rate
LMA	Loan Market Association
MCI	Multi-Currency Instrument
MCR	Multi-Currency Revolver
NIBC	Nederlandse Investerings Bank Capital
Num	Numerator
NV	Naamloze Vennootschap
NWIII	North Westerly III
OC	Overcollateralisation
PAS	Perfect Asset Swap
RA	Rating Agency
RCF	Revolving Credit Facility
RMBS	Residential Mortgage backed security
S&P	Standard & Poor's
SPE	Special Purpose Entity
SPV	Special Purpose Vehicle
US	United States
VFN	Variable Funding Note

1. Introduction

1.1. Introduction

NIBC is actively looking for innovative structures which allow it to generate liquidity by using the assets on its balance sheet or to arbitrage assets purchased in the market. Previously assets warehoused especially for this purpose, whether purchased in the market or internally originated. Unfortunately the market for CDOs has (momentarily?) evaporated; the unfavourable market conditions as a result of the credit crunch have resulted in a sharp decline in demand for these products. Even though the future of the CDO-market is uncertain, NIBC wants to be prepared for the eventuality of the market reopening. Therefore the company is actively researching innovative structures which could be used in future structured transactions.

One of the structures under study is related to multi-currency revolvers. Multi-currency revolvers are instruments consisting of a revolving note denominated in a currency other than the base currency of the majority of the notes issued by the CDO. These instruments combine the risks related to currency mismatches with the risks associated with revolving instruments.

As of yet, few transactions have been done which include multi-currency revolvers and limited information is available on this topic. NIBC has some experience with the inclusion of multi-currency instruments in its financial structures; however, they are interested in exploring alternative solutions to those used by them until now. Therefore the research objective of this thesis is formulated as:

- *To understand what kinds of multi-currency hedging techniques are currently applied in the market; and*
- *To assess the impact of the hedges used to manage the risk related to the multi-currency revolvers on the capital structure and costs associated with the structure.*

To provide structure to this research a number of research questions will be formulated in the following section. These research questions will serve as guidance during the research process and ensure that all necessary steps required to achieve the research objective will be taken.

1.2. Research questions

The first step to achieve the research objective(s) will be to document the basic properties of CDOs, and explain how they work. Subsequently, the role and influence of the rating agencies on the structuring process will be highlighted. This leads to the following research questions:

1) *What is a CDO? How does a CDO work? And what is the role of the rating agencies in the structuring of CDOs?*

The interest of NIBC, however, is not directed at CDOs per se, but specifically at the possibilities of hedging multi-currency risk. The organisation has been involved in CDO structuring for quite some time and has the knowledge and capabilities to successfully

complete a transaction. Some of its previous transactions have included assets denominated in currencies other than the CDO's base currency to increase the portfolio diversification. But while these foreign denominated assets increase the diversification benefits, they do introduce currency and interest rate risk to the structure.
Foreign currency risk emanates from fluctuations in the foreign exchange rate. Interest rate risk is a consequence of the different base interest rates specific to the different domiciles, for example EURIBOR in EMU-countries versus UK-Libor in the United Kingdom. These fluctuations can cause a mismatch between the value of the cash flows obtained from the assets (foreign currency) and payable to the liabilities (base currency). To hedge this mismatch NIBC has employed various hedging techniques, predominantly perfect assets swaps. These hedging techniques however have proven to be expensive and quite rigid. To reduce these negative consequences from hedging, NIBC is investigating the impact of the inclusion of revolving multi-currency notes in its CDO structures. In order to proceed with the research, the properties of these instruments will be documented and the consequences of their inclusion in CDO-structures will be investigated. The following research questions will cover these issues:

2) *What is a multi-currency revolver? And how does the inclusion of a multi-currency revolver influence the CDO capital structure and waterfall*[1]*?*

NIBC is not the first financial institution looking at multi-currency revolvers as a means to hedge currency exposure. Multi-currency revolvers have been used by other issuers. At present, a number of structures, which apply some form of a multi-currency revolver as a hedge for foreign exchange risk, are in the market.
Imitation is the sincerest form of flattery; instead of trying to reinvent the wheel, this thesis will first review the current practises employed in the market and compare their basic properties. This results in the third research question:

3) *What kind of hedging structures are currently being or have been employed in CDOs which include multi-currency revolvers?*

The hedging structures employed in several transactions will be investigated and classified into several categories.

The effectiveness of the various hedging structures found in existing CDOs will be tested on a base case model: an existing CDO structured by NIBC involving multi-currency assets. This modelling exercise and the subsequent comparison of the various structures are captured in the fourth research question:

4) *What is the impact of implementing these hedging structures in our base case model? And how should these structures be compared?*

The main hedging-structures will be implemented in the existing model, and used to structure a CDO that will comply with a predetermined set of requirement. These various

[1] The waterfall stipulates the rules by which the cash flow available to an issuer is allocated to meet the expenses, payments to transaction counterparties, and the debt service payments owed to holders of the various classes of security issued in connection with the transaction.

structures are likely to result in CDOs that differ in both risk and cost as well as in return on the equity tranche and ease with which reinvestments could occur. The results of this structuring exercise will be then compared based on a set of relevant criteria. This brings us to the most interesting and final research question:

5) *Which hedging structure which uses a multi-currency revolver provides the most efficient hedge for our base case CDO?*

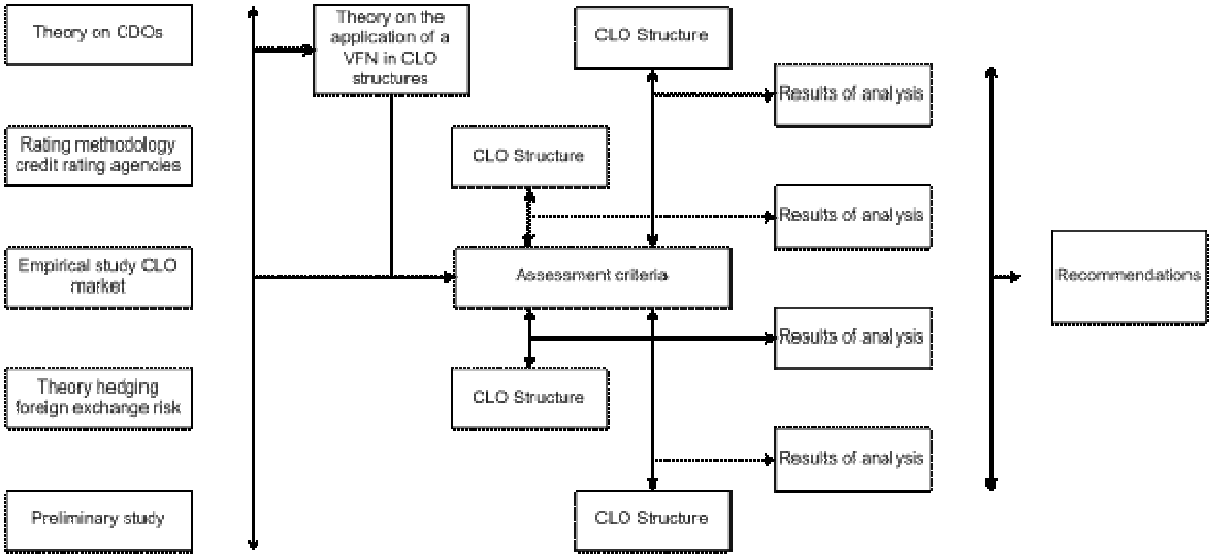
In summary the research performed in this thesis should allow for a comprehensive overview of the workings of a CDO, the implications of using multi-currency revolvers in CDO transactions and the performance of multi-currency revolving hedging structures. The comparison between the various structures identified in answering question 3, based on the criteria established under research question 4, will determine which hedging structure is most efficient and should thereby ensure that the research objective is achieved.

1.3. Research Methodology

To come to a general understanding of the steps that need to be taken in order to realise the research objectives a research framework is used. A research framework is a schematic representation of the research objective and visualises the research perspective (Verschuren and Doorewaard 2005).

The research framework used in this research project is depictured in figure 1-1.

Figure 1-1: Research Framework



Step 1:	Study the mechanics of CDOs, rating agencies' methodology, the CDO market, foreign exchange hedging techniques and preliminary study activities (such as expert discussions).
Step 2:	Document the current application of VFN in CDO structures.
Step 3:	Determine the main multi-currency CDO structures.
Step 4:	Create a number of criteria to objectively assess the performance of the various structures.
Step 5:	Analyse the performance of the structures using the criteria.
Step 6:	Formulate recommendations with regards to the usage of VFN in CDO structures.

The steps in this research framework are formulated, from left to right, as follows:

To achieve the research objectives as formulated in section 1.2 a diverse set of knowledge and skills will have to be developed. For example to be able to differentiate between benefits of the innovations in hedging foreign exchange risk and those of general hedging practises used in CDO structures, expert knowledge on market for CDO is required. Furthermore, to evaluate these innovations they will have to be tested in a CDO structure. To successfully complete the modelling of such a CDO, the mechanics of a CDO have to be understood. For a thorough evaluation process of the various structures sound criteria must be used.
Therefore in step 1 the theoretical framework will be established, stipulating the literature and knowledge sources used to execute the consecutive steps in this research project. The theoretical framework consists of general theory related to CDO structuring, hedging foreign exchange risk and the methodologies used by the rating agencies to stress test CDO structures. All these sources will be selected on the basis of a preliminary study conducted on this topic which included various lectures and expert interviews.

Scientific knowledge in the area of hedging foreign exchange risk in CDO structures using variable funding notes is lacking. Therefore this knowledge will first have to be gained by empirically studying of multi-currency CLOs which currently apply these techniques and are traded in the market, step 2. This initial study will contribute to answering the first part of the research objectives as formulated in section 1.2.

After having executed step two of this research framework, the main types of structures using VFNs should be established. To allow for a relevant comparison between them, these structures should be exposed to similar tests. The CDO structures should only differ with regards to the hedging technique they apply while keeping all else equal. These structures will be developed in step 3 of this research framework.
The criteria used in assessing these structures should allow for a fair and objective comparison between the various structures, while testing for the relevant features of the structures. The criteria should facilitate an easy comparison between the performances of the various structures given the hedging technique used. The appropriate criteria for this process will be established in step 4.

The results obtained at step 5 will be the outcome of the assessment of the different structures and will form the basis of the recommendations. The gist of these recommendations will be derived from a mutual comparison between the performance of the structures and from the results of an analysis of the behaviour of each individual structure.

At the utmost right, indicated with step 6 in the above figure, the recommendations indicate the final step of this research project. These recommendations should constitute an answer on the research objectives. In other words, they should explain the impact of the various hedging structures on the performance of CLOs and therewith conclude this research.

1.4. Research strategy

In order to accomplish the steps set out in the research framework and thus fulfil the research objective, three types of research strategies will be applied: desk research, ground theory approach and experiments.

Desk research

The initial steps in this research will constitute of desk research in which existing materials are used such as NIBC's internal documents, relevant books, research papers, rating agency reports and market data. These materials provide an accessible and comprehensive source of information and provide the necessary knowledge to formulate answers to research questions 1, 2 and 4.

The grounded theory approach

Unfortunately desk research will fall short of answering the third research question, which requires a degree of knowledge not found in any readily available sources. Therefore, in answering these questions a different research strategy will be applied: the grounded theory approach. By using the grounded theory approach different theoretical insights can be gained by studying and comparing the characteristics of different CDO structures which are currently used in the market. This part of the research will determine which factors are common to multi-currency CDO, establishing the essential features of VFN based hedging structures. Therewith this approach will result in the documentation of new theoretical concepts and contribute to the theory developing approach of this research.

Experiments

The final research questions, question 4 and 5, will be answered using an experimental research strategy. The theory developed by applying desk research and the ground theory approach will be tested and evaluated. This testing and evaluating should be considered as a laboratory experiment based on computer simulations in which all outside factors are strictly controlled. In other words, the different CDO structures which will be created based on the developed theory will be exposed to exactly the same factors and only differ with regards to the variables designated for testing. Using this type of experiment will result in an objective conclusion with a high degree of internal and external validity

The results of this experiment are compared ex-post based on the criteria developed in step 4 of the research framework and consequently make the basis of the recommendations, presented in the form of a conclusion.

2. Collateralised Debt Obligations (CDO)

2.1. Introduction

Collateralised debt obligations, commonly abbreviated as CDOs, are usually viewed as inordinately complex structured financial products; tough to create and probably even tougher to understand. But while these products surely are more complex than ordinary bonds, the theory behind collateralised debt obligations is by no means rocket science.
To assist in the conceptualisation of this complex concept the basic theory behind a CDO will be explained in this introductory chapter. Doing so, the first research question, as formulated below, will be answered.

1) *What is a CDO? How does a CDO work? And what is the role of the rating agencies in the structuring of CDOs?*

To achieve this goal, the concept of a CDO is introduced in section 2.2. Thereafter the mechanisms put to work in a CDO will be described in section 2.3. Followed by a discussion on the role the rating agencies play in the creation of a structured financial product such as a CDO in section 2.4. Finally this chapter will be concluded with section 2.5, in which a short overview of the main reasons why investors purchase CDOs is presented.

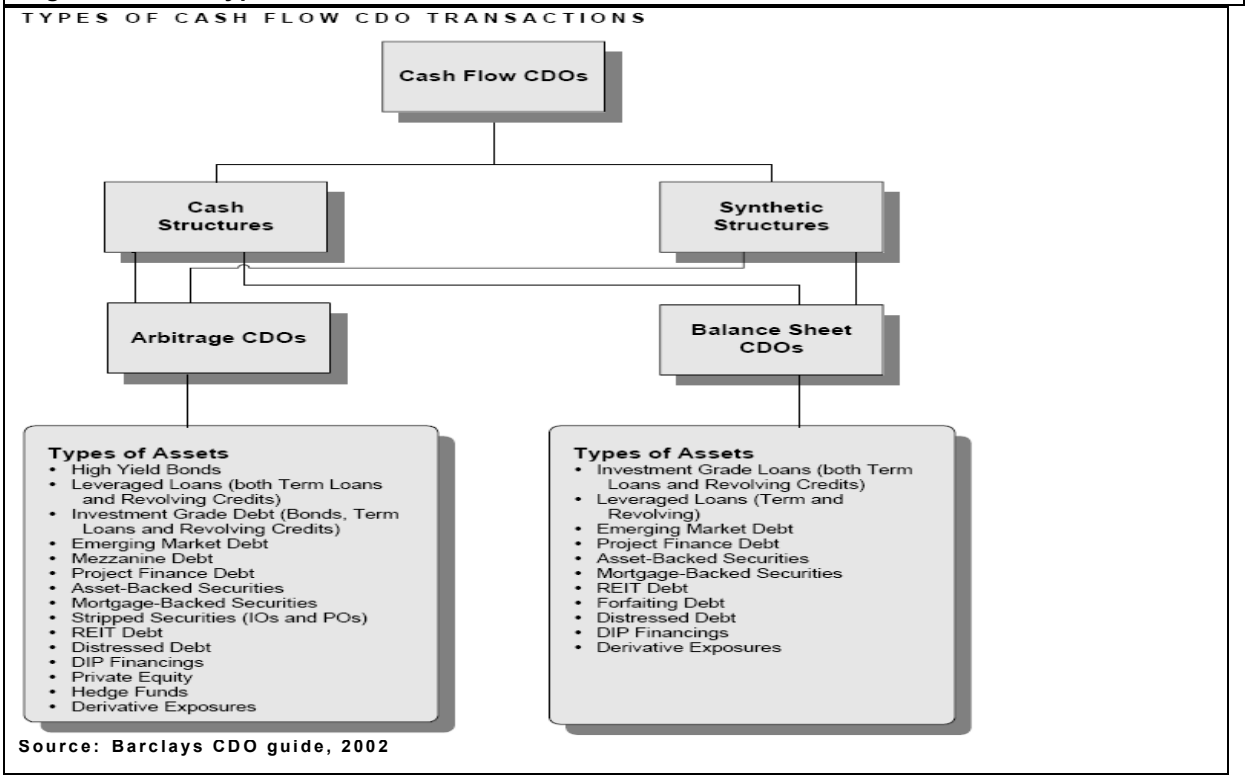
2.2. What is a CDO?

Collateralised debt obligations, or CDOs, are structured vehicles that are similar to leveraged closed-end funds (Standard & Poor's, 2002). In other words, a CDO is similar to a regular mutual fund that buys bonds. Unlike a mutual fund, however, the CDO issues bonds, rather than shares, to raise the necessary capital to purchase these bonds. In simplest terms, a CDO is an arrangement that raises money primarily by issuing its own (rated) bonds with different levels of risk and return. The proceeds are then invested in a portfolio of bonds, loans, or similar assets (Nomura Fixed Income Research, 2004). But not always does a CDO own the assets outright. Sometimes the CDO acquires exposure to these assets synthetically by entering into a credit default swap (CDS Figure 2-) (J.P. Morgan Securities Inc., 2001). In a credit default swap, the CDO receives a periodic payment from the swap-counterparty (the protection buyer) in exchange for protection in case of a default on the reference asset. The payments received on the real and synthetic assets in the portfolio are the main source of funds for repaying the CDOs own securities.

2.2.1. Types of CDOs

CDOs can be classified by 1) structural characteristics, 2) issuer motivation, 3) asset class composition, and 4) the region or country of the collateral (Figure 2-2-1).

Figure 2-2-1: Types of cash flow CDO transactions



Source: Barclays CDO guide, 2002

2.2.2. Classification by structure

CDOs can be broadly divided into three structural categories: cash structures, synthetic structures and market value structures (NIBC, 2008-3).

Cash structures are the most commonly used structures in the current market. The CDO uses the cash obtained by issuing the notes to the investors to buy assets (Barclays, 2002).

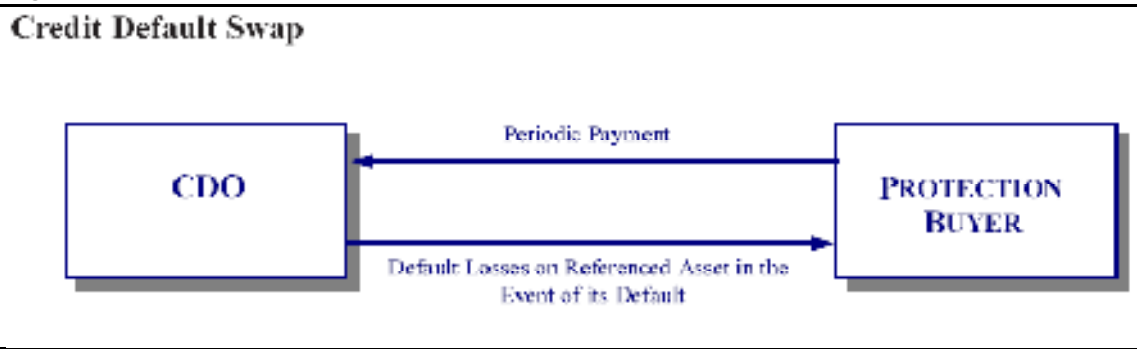
Synthetic structures do not buy the assets outright, but achieve exposure to the reference asset by issuing credit protection in the form of CDS (Figure 2-) (NIBC, 2008-1). This structure is sometimes preferred to the cash structure in balance sheet CDOs issued by banks, as synthetic securities do not require the transfer of assets. The transferability of the bank's assets might be limited by the accompanying loan documentation.

There are two types of synthetic CDO structures: non-funded and partially funded (NIBC, 2008-1). Non-funded synthetic CDOs issue no securities at all, while partially funded structures issue securities to partially fund the acquisition of assets.

Market value structures are similar to cash flow CDOs, but the SPV does not issue liabilities on the par value of the assets. Rather the SPV issues liabilities based on the advance rate associated with the type of assets purchased (Standard & Poor's, 2002).

Market value structures are disregarded for the remainder of this thesis due to their different nature, limited market-share and the significant difficulties revolving around the valuation of the underlying assets under the current market conditions.

Figure 2-2: Credit Default Swap



Source: J.P. Morgan Securities Inc., 2001

2.2.3. Classification by issuer's motivation

When looking at the motivation of the issuer, CDOs can be classified into two types: arbitrage CDOs and balance sheet CDOs (NIBC, 2008-1).

Arbitrage cash flow CDOs issuance is driven by either opportunities in capital market dislocation (arbitrage) or regulatory capital-relieve motivations. The issuer of arbitrage CDOs tries to profit from the spread between relatively higher-yield assets and lower-cost, more highly rated liabilities (Standard & Poor's, 2002). The greater the spread between the coupons received from the assets and paid to the rated liabilities, the greater the potential leveraged yield on the equity. As a result, the return on CDO equity, in the absence of defaults on assets, greatly exceeds the weighted average coupon earned on the underlying portfolio.

In contrast, *balance sheet CDOs* issuance is motivated by the desire of the sponsoring institution to reduce regulatory capital requirements, increase lending capacity, lower the cost of funding, manage risk, and/or diversify funding sources (Standard & Poor's, 2002). These goals can be reached either by the sale of the specific assets or the transferring of the risks related to the reference assets synthetically (Barclays, 2002).

2.2.4. Classification by Asset Class

A Collateralised debt obligation is commonly defined in terms of its assets. The general definition is that a CDO is a securitisation of (corporate) obligations. By order of volume, CDOs have securitised (or re-securitised) among others: commercial loans; corporate bonds; asset backed securities (ABS), residential mortgage backed securities (RMBS), and commercial mortgage backed securities (CMBS); and emerging market debt. Even tranches (parts) of CDOs have been re-securitised into CDOs of CDOs. Which were dubbed CDO-squared (CDO2) or CDO-cubed (CDO3) (J.P. Morgan Securities Inc., 2001).

2.2.5. Classification by Country or Region

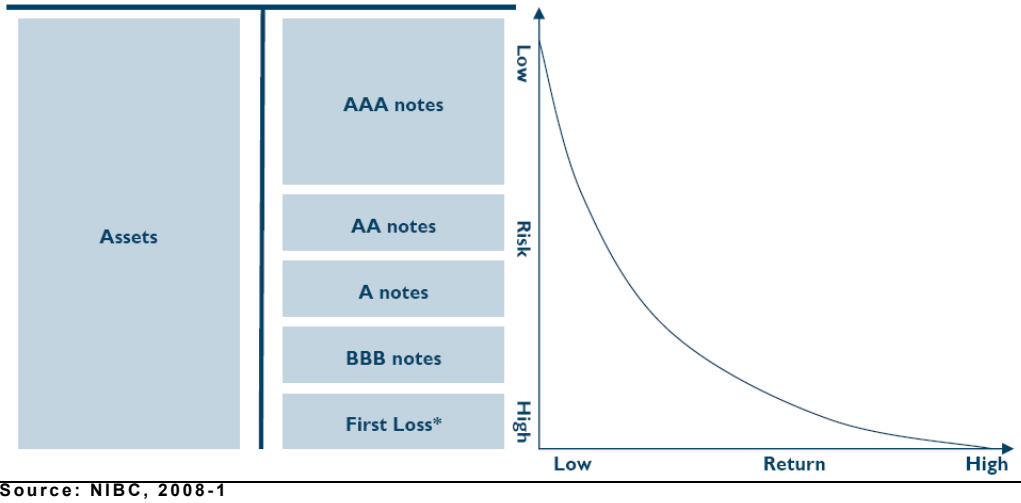
A final way to classify CDOs is by defining the region of country of the domicile of the obligors or the assets.

2.3. How do CDO's work?

2.3.1. The structural components of a CDO

At the core of the CDO is a bankruptcy-remote *special purpose vehicle* (SPV), generally registered as *charitable trusts* (the Trust) and usually established in a tax-free jurisdiction. The SPV is either classified as either a *pass-through* or *pay-through* structure. Pass-through structures pass the entire principal and interest proceeds obtained from the assets to the investors (Giddy, I., 2002). Pay-through structures are more actively managed and allow for reinvestment of cash flows, restructuring and the purchase of additional collateral (Tavakoli, 2008). The SPV issues the securities to the investors in the form of several classes of notes that are divided or tranched into differently rated and some unrated securities. Each class of securities represents a different level of risk and reward associated with the asset pool. The most senior securities have the credit ratings higher than the average ratings of the underlying collateral pool due to the diversification of risk and the subordination of lower rated tranches. The lower tranches of the CDO are being rated below the seniors. The first-loss tranche is usually called the equity (or preferred shares), even though, strictly speaking it is not equity. This tranche is typically not rated (Standard & Poor's, 2002). Within the structure of a CDO, risk and return share a lateral relation; the more senior or secure the note, the lower its return (Figure 2-).

Figure 2-3: Relation between risk and return for the CDO tranches)



Source: NIBC, 2008-1

In anticipation of the expected proceeds from the sale of the notes, the asset manager of the SPV's assets, who is appointed by the Trust, starts to acquire (or "warehouse") assets

(NIBC & Baker & McKenzie LLP, 2008). To obtain exposure to these assets, either directly by buying the assets from the market or the sponsoring institution (originator) or synthetically by means of CDS (Figure 2-). This period is typically called the *pre-closing period*, as it covers the period between the initiation and the closing of the transaction.
On the closing date or, in most cases, during the "*ramp-up period*" of between 60 and 180 days following the closing date, the SPV purchases the assets with the proceeds from the sale of debt and equity (NIBC & Baker & McKenzie LLP, 2008). Subsequently, many SPVs enter into hedging agreements to cure, among others, mismatches between payment dates of interest received on the assets and the interest payable on the notes.

Figure 2-4: SPV purchases assets

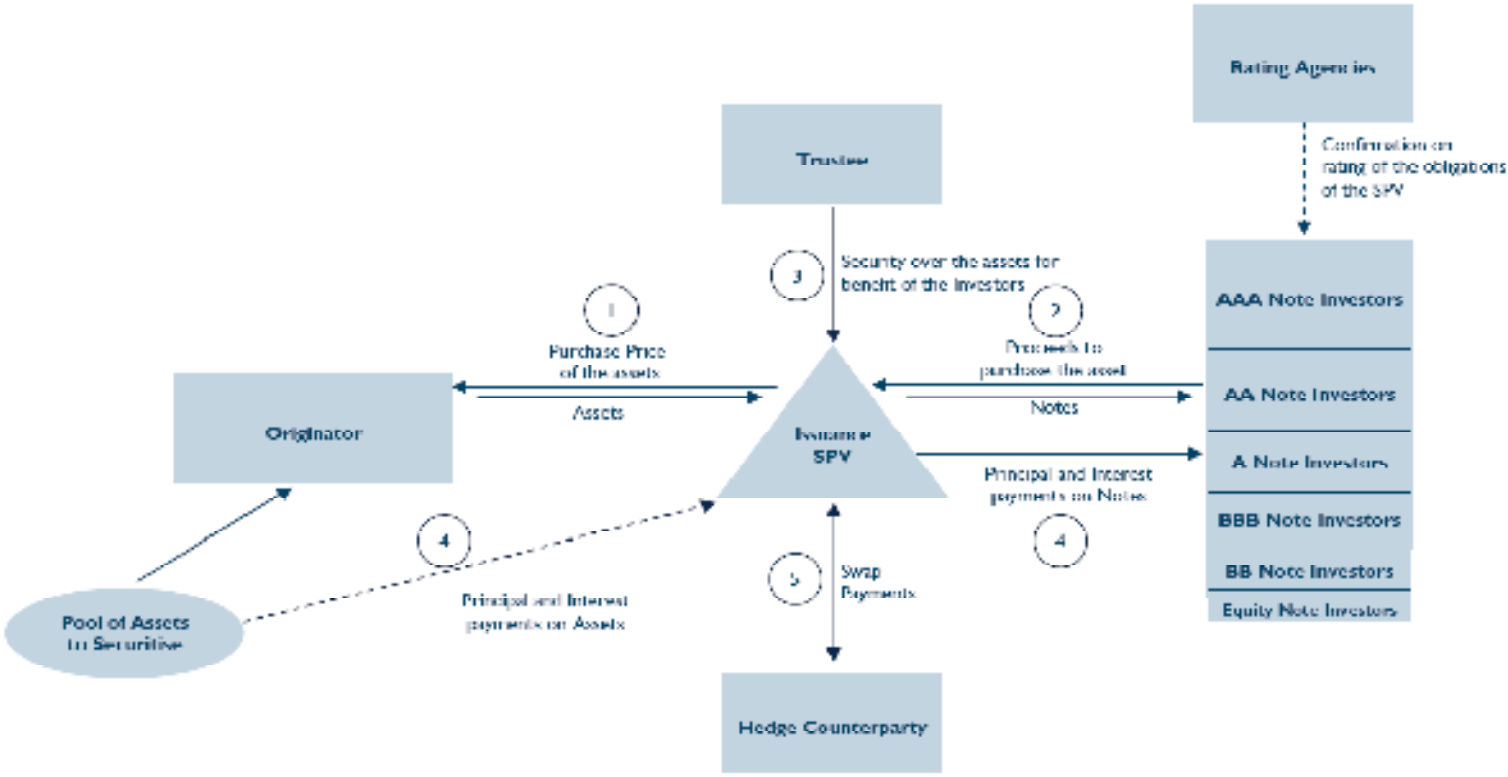
Source: NIBC, 2008-1

The purchased assets remain in the SPV under supervision of an asset manager. The asset manager is mandated by the charitable trust to manage the assets in accordance with the transaction guidelines. Often the asset manager has broad discretion to purchase and trade collateral and reinvest proceeds received due to prepayments and amortisation of the assets under management. The asset manager therefore plays a key role in each CDO transaction.
In balance sheet transactions, however, the asset manager, usually an associate of the issuing bank, plays a more limited role, which mostly consists of administering and servicing assets transferred from its balance sheet.

The workings of a cash-flow CDO process is summarised in

Figure **2-**.

Figure 2-5: Cash flow securitisation



1: The originating company sells a portfolio of receivables to the SPV
2: SPV finances the purchase of the receivables by issuing a combination of notes with rating ranging from unrated up to AAA
3: A trustee oversees the SPV and protects the interests of the noteholder
4: Principal and Interest Payments on the assets are used to service interest and principal payments on the notes
5: To hedge the mismatch between the interest paid on the assets and the those paid on the notes the SPV may enter into hedge agreements

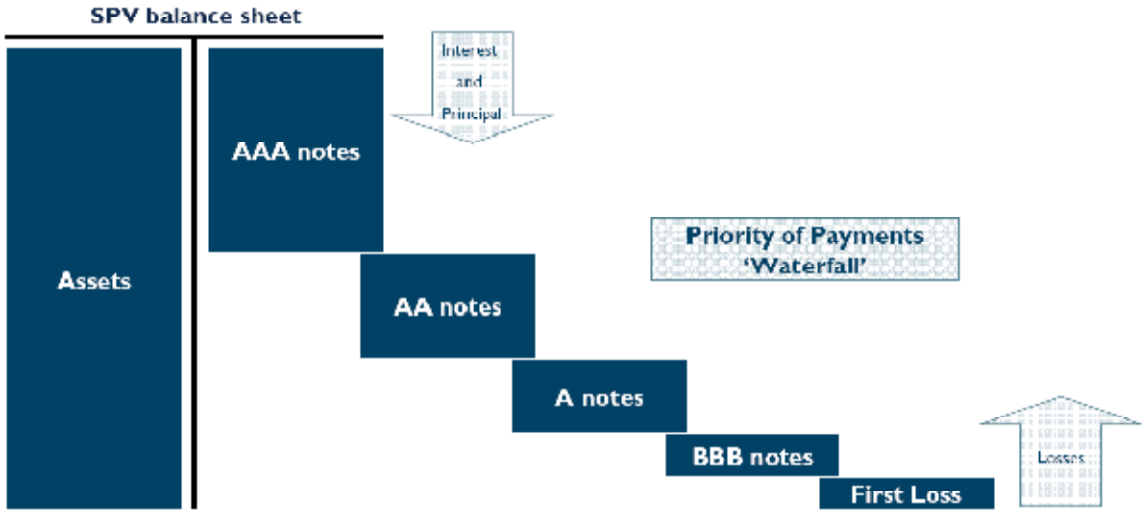
Interest proceeds

During the lifetime of the CDO, the SPV will receive interest income on its assets and/or premium on the synthetic products. The interest and premium received is distributed to the note holders according to the priority of payment, indicated by the CDO's waterfall Figure 2-). The purpose of the interest and principal waterfalls is to protect the seniority of the tranches. It is therefore very important that investors know how the interest and principal waterfalls work in relation to the tranche they hold (Barbican consulting, 2007). In simple terms, the higher the tranche is located on the waterfall, the lower the risk related to the note as the amount of subordinated collateral and priority of payment is high.

In general interest payments follow the order of priority, subjected to the CDO transaction documentation (Barbican consulting, 2007):

1. Trustees fees
2. Swap interest payments
3. Asset management fees
4. AAA interest
5. Mezzanine interest
6. Equity holders
7. Holders of any excess spread or interest notes

Figure 2-6: CDO waterfall



Source: NIBC, 2008-2

Overcollateralisation (OC) test

In order to pay interest to the individual tranches an overcollateralisation (OC) and interest coverage (IC) test must be passed.

The OC test is designed to maintain a minimum level of subordination for each tranche in case of one or more defaults in the collateral pool. Senior tranches will have a higher threshold level for the OC test than junior tranches (NIBC, 2007-1).

$$OCtest\ of\ note\ X = \frac{CDO\ Principal\ Balance}{Notional\ value\ of\ note\ x + \ Senior\ ranking\ notes}$$

The numerator is CDO Principal Balance which is modelled as the sum of performing assets at par value (face value), defaulted assets at expected recovery value (or zero depending on the transaction's documentation), and principal proceeds. The denominator is equal to the sum of notional amounts of notes senior and pari-passu with (carrying

equal rights as) the relevant note (NIBC, 2007-1). If the test is breached (e.g. when the result of the division is below a predefined level), interest proceeds, and to the extent that they are insufficient, principle proceeds will be diverted from subordinate distributions to redeem senior notes, in order of priority of payments until the OC test that has been breached is brought back in compliance.

Interest Coverage (IC) Tests

$$ICtest = \frac{Available\ interest\ proceeds}{sum\ of\ interest\ payments\ due\ on\ notes\ senior\ or\ pari-passu\ with\ the\ relevant\ note}$$

In addition to the OC test some CDO includes an IC test. The IC test measures the CDOs ability to generate sufficient interest income on its assets to meet its liabilities. For each tranche a minimum IC ratio has to be maintained. This ratio increases with the seniority of the note. The IC ratio is calculated by dividing the interest proceeds by the interest on the more senior ranking tranches plus interest on the tranche itself.

More specifically; the numerator is modelled as the total amount of available interest proceeds from portfolio assets (after the payment of senior costs). The denominator is equal to the sum of interest payments due on notes senior or pari-passu with the relevant note (NIBC, 2007-1).

If the test is breached, interest and principal proceeds, to the extent that interest proceeds are insufficient, will be diverted from subordinate distributions to redeem senior notes, in order of priority until the IC test that has been breached is back in compliance.

Non-interest related proceeds

Next to interest income, the SPV will receive prescheduled payments based on the amortisation of the assets and prepayment on assets which are being liquidated. Funds received are either used to redeem notes, starting with the most senior according to the CDO waterfall, or are reinvested, subject to all coverage tests being passed. Reinvestments are made by the asset manager during the predetermined reinvestment period(s) provided that the asset mix meets the CDO's investment guidelines (Offering Circulars 2006-2007[2]). Reinvestment of unscheduled proceeds (usually coming from prepayments) is sometimes allowed also after the reinvestment period, provided that the Weighted Average Life of the portfolio does not exceed the covenanted value.

[2] Here within "Offering Circulars" will referrer to the information obtained by studying the offering circulars of European CDOs of leveraged loans issued between January 2006 and June 2007. An overview of the relevant CLOs can be found in Appendix A.2

Role of the rating agencies

After reading the previous sections of this chapter it might seem that CDOs are inordinately complex structured financial products. Indeed, the structures of many present days CDOs, combined with various swaps and derivatives, do ensure that CDOs are more complex than "traditional bonds". However, even the most complex synthetic CDOs theoretically involve cash flow projections which can be quantitatively modelled (OICV-OISCO, 2008). Sophisticated institutional investors use these cash flow projections to value the CDO's notes and create their own stress scenarios to test the behaviour of the CDO under different conditions. But while these investors often have the capability to analyse the risk comprising the tranches of a CDO, doing so can be time consuming even where risk modelling is almost entirely automated (OICV-OISCO, 2008).

To facilitate the analysis of the risk accompanying a CDO many issuers involve rating agencies (RA). These rating agencies function as an outside and independent agent hired by the issuer to provide their opinion of the future ability and legal obligation of the CDO to make timely payments of principle and interest (S&P, 1998; Moody's, 1998). To form their opinion the RA may obtain non-public information from the borrowers and issuers as input for the quantitative models used as part of their rating process (OICV-OISCO, 2008). Thereby the rating agencies alleviate the information asymmetry between the investors and issuer (Coval, Jurek & Stafford, 2008) and could potentially reduce the amount of effort investors have to put into their own risk analysis (Croughy, Galai & Mark, 2000). In addition the opinion of the rating agencies makes the structured financial products market accessible to less sophisticated investors. Those investors use the RA's opinion as a substitute for their own analysis and interpret the rating agency's opinion as a seal of approval (OICV-OISCO, 2008).

The opinion of the rating agencies is usually expressed in the form of a combination of letters and numbers symbolising the probability of default and the loss given default (Tavakoli, 2005; Merton 1974). The most well known rating agencies, involved in CDO structuring, are Moody's, S&P and Fitch IBMC. An overview of their ratings is given in Table 2-1(Tavakoli, 2008).

2.3.3. The credit rating process

Even though structured financial products and corporate bonds are assigned a similar type of rating by the rating agencies to indicate their respective creditworthiness, their rating process can appear to be almost reversed. This perception is not entirely without merit given that a RA rating of a structured financial product is qualitatively different from a corporate bond rating. The opinion of a RA on a corporate bond is the result of an analysis of the issuer's past financial statements, while in a structured finance transaction, the RA provides the investment bank with input into how a given rating can be achieved (i.e., through credit enhancements; the process of reducing credit risk by requiring collateral, insurance, or other agreements to provide the lender with reassurance that it will be compensated if the borrower defaulted) (OICV-OISCO, 2008).

Structured financial products are in a sense designed for a particular credit rating. The issuer of a structured product often decides beforehand what rating it would like for each

tranche (presumably within the limits of what is possible) and tailors the cash-flow risk – as measured by the likelihood of default and loss given default – to satisfy the guidelines set forth by the credit rating agencies (Coval, Jurek, & Stafford, 2008).

The issuer estimates based on quantitative models and other factors how many of the loans in the collateral pool would be expected to default under the stresses of varying severity applied by the rating agencies. This analysis also includes assumptions as to how much principal would be recovered after a defaulted loan is foreclosed (OICV-OISCO, 2008). The expected loss is applied to determine how much credit enhancement a given tranche security would need to get a particular credit rating. For example, the severest stress is run to determine the credit enhancement required for a AAA-rating. This stress-test provides an indication of the rating agency's expectation of the worst case scenario which the structure should be able to withstand.
Put another way, the tranches below AAA would need to be sized such that they could incur a minimal percentage of loss in the aggregate principal of the collateral pool before any loss would be allocated to the AAA tranche (OICV-OISCO, 2008). The structure is then tranched accordingly.

The process of analysing and tranching requires close cooperation between the rating agencies and the issuer and is inherently iterative in nature. The rating agencies are a constant source of necessary inputs for the quantitative analysis during the structuring process. Mostly these inputs are related to the severity of the stresses, expected recoveries and required credit enhancement.
In the final step in the rating process, the tranching proposed by the issuer, based on the comments received from the RA, is validated by the rating agency by running its own quantitative models. When the RA feels comfortable with the structure, it will provide the desired credit ratings to the different tranches. Otherwise the issuer will have to amend the structure, for example by increasing the amount of credit enhancement, and propose this new tranching to the RA. The RA will consecutively test the structure and provide its opinion. This iterative process is continued until the RA feels secure to provide the desired rating to the updated structure.

Table 2-1: Credit Ratings

	Moody's		S&P		Fitch	
	Long Term	**Short Term**	**Long Term**	**Short Term**	**Long Term**	**Short Term**
Prime	Aaa		AAA		AAA	
High grade	Aa1		AA+	A-1+	AA+	A1+
	Aa2	P-1	AA		AA	
	Aa3		AA-		AA-	
Upper medium grade	A1		A+	A-1	A+	A1
	A2		A		A	
	A3	P-2	A-	A-2	A-	A2
Lower medium grade	Baa1		BBB+		BBB+	
	Baa2	P-3	BBB	A-3	BBB	A3
	Baa3		BBB-		BBB-	
Non Investment grade speculative	Ba1		BB+		BB+	
	Ba2		BB		BB	
	Ba3		BB-	B	BB-	B
Highly Speculative	B1		B+		B+	
	B2		B		B	
	B3		B-		B-	
Substantial risks	Caa1		CCC+			
Extremely speculative	Caa2	Not Prime	CCC			
In default with little prospect for recovery	Caa3		CCC-	C		C
In default with little prospect for recovery	Ca		CC		CCC	
In default	/				DDD	
	/			/	DD	/
	/		D		D	

S&P's Long-term ratings definitions

'AAA': An obligation rated 'AAA' has the highest rating S&P assigns. The obligor's capacity to meet its financial commitment on the obligation is extremely strong.
'AA': An obligation rated 'AA' differs from the highest-rated obligations only to a small degree. The obligor's capacity to meet its financial commitment on the obligation is very strong.
'A': An obligation rated 'A' is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligations in higher rated categories. However, the obligor's capacity to meet its financial commitment on the obligation is still strong.
'BBB': An obligation rated 'BBB' exhibits adequate protection parameters. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitment on the obligation.

Obligations rated 'BB', 'B', 'CCC', 'CC', and 'C' are regarded as having significant speculative characteristics. 'BB' indicates the least degree of speculation, and 'C' the highest. While such obligations likely will have some quality and protective characteristics, these may be outweighed by large uncertainties or major exposure to adverse conditions.

'BB': An obligation rated 'BB' is less vulnerable to non-payment than other speculative issues. However, it faces major ongoing uncertainties or exposure to adverse business, financial, or economic conditions that could lead to the obligor's inadequate capacity to meet its financial commitment on the obligation.
'B': An obligation rated 'B' is more vulnerable to non-payment than obligations rated 'BB', but the obligor currently has the capacity to meet its financial commitment on the obligation. Adverse business, financial, or economic conditions likely will impair the obligor's capacity or willingness to meet its financial commitment on the obligation.
'CCC': An obligation rated 'CCC' is vulnerable to non-payment within one year, and depends on favourable business, financial, and economic conditions for the obligor to meet its financial commitment on the obligation. In the event of adverse business, financial, or economic conditions, the obligor is unlikely to have the capacity to meet its financial commitment on the obligation.
'CC': An obligation rated 'CC' currently is highly vulnerable to non-payment.
'C': The 'C' rating is also used when a bankruptcy petition has been filed or similar action has been taken but payments on this obligation are being continued. 'C' is also used for a preferred stock that is in arrears (as well as for junior debt of issuers rated 'CCC-' and 'CC').
'D': Default; 'SD': Selective default. The 'D' and 'SD' ratings, unlike other ratings, are not prospective; rather, they are used only when a default actually has occurred—not when default is only expected.

Plus (+) or minus (-): The ratings from 'AA' to 'CCC' may be modified by the addition of a plus or minus sign to show relative standing within the major rating categories.

Source: S&P 2008

2.4. Why would anyone buy a CDO?

The questions above arise from the recognition that the cost of CDO tranches exceeds the cost of CDO assets. The difference goes to pay professionals associated with the transaction: security firms, asset managers, trustees, rating agencies, attorneys, and accountants. Why do investors buy CDOs that cost more than the assets the CDO holds? (J.P. Morgan Securities Inc., 2001)

In the literature a variety of reasons can be found why investors buy CDOs. The most important reasons are related to increased yield potential, market segmentation and risk diversification.

For many investors a securitised instrument holds the promise of a significant yield premium over equally rated, and therefore assumed to be equally risky[3], issues such as sovereign government bonds (Giddy, 2002). The diversified portfolio and the credit enhancement techniques used in the structured products are deemed to ensure the timely payment of the interest and repayment of the principle proceeds, while promising a handsome return on investment. The lack of other seemingly sound and highly rated investments made investors flock to the market for ABS.

Other investors were largely motivated by the opportunity CDOs provided to diversify their asset portfolio. Rules and regulations prohibit specific classes of investors, mostly pension funds, to invest in sub-investment grade commercial paper[4]; resulting in market segmentation (OICV-OISCO, 2008). By disallowing these investments such regulation severely limits the investors' ability to diversify risks over a variety of asset classes, industries or countries.

These constrains are mitigated by the CDO tranched structure. This structure allows for the creations of custom exposures, regardless of the underlying assets, that investors desire and cannot achieve any other way. Therefore these custom exposures fit into investors various risk appetites and capital constraints.

An additional explanation for the demand for CDOs is based on the observation that the CDO structure allows equity investors to earn leveraged returns on the underlying assets at the cost of bearing greater risk (J.P. Morgan Securities Inc., 2001). By purchasing the junior or first loss tranche of a CDO the equity investor obtains a leveraged exposure to the assets in the asset portfolio. The investor obtains this leveraged exposure without having to borrow funds from external parties.

[3] Obviously this assumption proved to be invalid during the financial crisis.

[4] For example, Rule 2a-7 of the Investment Company Act specifies that money market funds can only purchase commercial paper if it is of sufficiently high rating.

2.5. Conclusion

In this chapter the concepts behind a CDO were introduced and the first research question was answered. It was found that a CDO is basically a structured financial product consisting of a pool of assets backing several liabilities, not unlike a regular mutual fund. In order to purchase this pool of assets, the CDOs issuer creates number of different notes, each with its distinctive risk and reward profile. Every category of rated notes is dubbed a tranche. These notes, the CDOs liabilities, are rated by the rating agencies and sold to different investors. Under normal conditions the income received on the assets is sufficient to pay interest to the CDOs liabilities. Structural mechanisms included in the CDO should ensure that even under irregular conditions the safety of the notes remains unquestionable. The soundness of the CDO structure is tested by the rating agencies, which express their opinions in the form of a credit rating. The rating provides additional confidence in the ability of the CDO to fulfil its liabilities and is a prerequisite for certain groups of investors to be able to purchase the offered notes. Therewith this introductory chapter is concluded and the first research question answered.

Now that the concept of a CDO has been properly introduced, the risk related to these structured financial products will be explained in the next chapter. In addition this chapter will present the concept of a variable funding note; a revolving facility usually used to hedge against foreign exchange risk.

3. The risks related to CDOs

3.1. Introduction

The previous chapter provided an elaborate introduction of the concept of a CDO. The focus of this research project is, however, not directed at CDOs per se, but specifically on the methodologies which can be used to hedge multi-currency risk in these types of structures. In a CDO backed by assets in different currencies than the issued liabilities movements in the relevant FX rates could adversely affect coverage ratios and consequently the performance of the transaction. This multi-currency has been traditionally mitigated with conventional techniques such as swaps and/or options. Recently, however, a novel hedging instrument has been introduced in the CDO market. This technique ingeniously applies a variable funding note or multi-currency revolver to hedge the risk related to a multi-domestic asset portfolio. To get familiar with this new hedging technique, this innovation will be discussed in this chapter. Consequently, this chapter will answer the second research question:

2) *What is a multi-currency revolver? And how does the inclusion of a multi-currency revolver influence the CDO capital structure and waterfall?*

To answer this research question, the main risks involved in investing in a CDO will first be introduced in this chapter. In a CDO risks emerge for example from the complexity of the structure (in other words the investor's ability to comprehend the proposed structure), the underlying assets and systemic risk. These last two types of risks will be introduced in section 3.2. Section 3.3 will continue this introduction with a discussion focussed on foreign exchange risk and the hedging techniques used to hedge this risk. As one of these hedging techniques, the VFN will be addressed in section 3.3.4.

3.2. Different types of risk

Similar to other financial products, an investment in CDOs involves significant risks. Understanding of the risks related to an investment in a structured financial product is an imperative for the CDO investors in order to determine whether the potential investment meets their predefined risk and return requirements. The main risks associated with an investment in a CDO are explained below. Due to the relative importance of foreign exchange risk for this thesis this risk will be studied a bit more in depth.

3.2.1. Credit risk

In general terms, credit risk is the risk that a change in the credit quality of borrower will affect the market value of the underlying collateral position. Defaults, whereby counterparty is unwilling or unable to fulfil its contractual obligations, is the extreme case; however, investor are also exposed to risks that the counterparty might be

downgraded by a rating agency (Croughy M., Galai D. & Mark R., 2000). With regards to CDOs, credit risk mainly emanates from the risk of default[5] on the investment portfolio.
The overcollateralisation test, introduced in section 2.3.2, provides protection from losses related to credit risk to the rated notes. The equity investors, who do not have the benefit of overcollateralisation or subordination, are more exposed to credit risk as they are the last to receive any interest or principle proceeds. Hence, in case of a default the most junior tranche (usually referred to as equity) suffers the first loss, as was indicated by the waterfall (Figure 2-) (The Economist, 2002).
Similarly, in synthetic structures the principle amount of the equity tranche is reduced by notional amount of the defaulted loan minus its recovery value. As long as there is equity remaining, additional defaults will result in a further reduction of the equity tranche until the value of the equity tranche reaches zero. Subsequent defaults will result in a reduction of the principle amount of the more senior tranches, as is indicated by the transactions waterfall.

3.2.2. Interest rate risk

The risk related to interest rate arises from various factors in CDOs and depends on the complexity of structure and the nature of hedging. In most arbitrage cash flow CDOs it is included in the form of basis risk i.e. a mismatch between fixed and floating rates asset and liabilities (Barclays, 2002). Basis risk in CDO is usually hedged with interest rate swaps, caps, and/or floors. However, the interest rate risk in CDOs is difficult to hedge fully due to the active management of assets, limited ability to buy or sell interest rate hedges, high purchase price, active management and embedded optionalities.

3.2.3. Liquidity risk

Liquidity risk relates to the relative ease with which the assets in the asset portfolio can be traded (Giddy, 2002). One of the benefits obtained by the CDO Arranger is the opportunity to provide liquidity to otherwise illiquid assets. The fact that the CDOs serve as an important liquidity provider indicates that the market for the CDOs collateral is otherwise limited. Depending on the amount of exposure to the relatively illiquid assets, the asset manager may not be able to liquidate / substitute some assets when needed. This risk arises in CDOs from the inclusion of zero-coupon bonds, step-up bonds, PIK bonds, and bonds that make interest payment less frequent (e.g. annually) than the notes issued by the CDO (e.g. semi-annually) (Barclays, 2002).

3.2.4. Prepayment risk

Prepayment risk stems from the possibility of an early unscheduled return of principal on an underlying security (Jobst, 2002). In case that the unscheduled proceeds cannot be reinvested either because of the CDO's structure or because of breaching of relevant

[5] It should be noted that: while a default mainly results from the explanation above, this definition is merely illustrative. In practise the definition of a default is subjected to the legal documentation accompanying the transaction; predominantly its offer circular and term sheet.

triggers these proceeds will be used to redeem the notes. Consequently the prepayment risk of the assets is passed to the notes, albeit diluted by the number of assets in the pool. In structures with sequential redemption of notes, this risk is borne by the senior note.

3.2.5. Reinvestment risk

Reinvestment risk stems from the possibility that the asset manager cannot find suitable assets in which to invest the principal proceeds when allowed or to use for substitution of impaired[6] assets in the pool the investor's investments. The ability to reinvest reduces the prepayment risk for the senior notes and the risk related to the CDO; however it introduces the possibility of negative carry as delayed reinvestments of prepaid principle and other cash receivables could cause the interest income to temporarily become lower than the interest paid on the liabilities (Giddy, 2002 & Barclays, 2002).

3.2.6. Asset manager risk

The expertise of the asset manager (or collateral manager) and his ability to manage the portfolio are inextricably linked with the CDOs performance. The experience of the asset manager therefore plays an important part in the risk assessment performed by the rating agencies. Post closing the main risk borne by the investors relates to a change of the asset manager.

3.2.7. Counter party/ bivariate risk

CDOs typically limit the counterparty credit risk by dealing only with highly rated entities for interest rate hedges, foreign currency hedges, credit derivates, loan participations and securities lending (if any) (Offering Circulars, 2006-2007). Bivariate risk in CDOs refers to the risk that payments on an underlying debt instrument could be interrupted by the declining credit quality of another entity (Barclays, 2002).

3.2.8. Systemic or non-idiosyncratic risk

Obviously all of the risks discussed above will be more pronounced in an economic downturn that may result in large-scale ratings downgrade and/or defaults. Diversification of the portfolio's asset should limit the impact of idiosyncratic (asset specific) risk spread due to limited correlation between assets. Sharp increase in ratings downgrade is concomitant with economic downturn and emblematic of systemic risk, which cannot be mitigated through diversification. Systemic risk harbours the potential to reduce the market value of all the assets held in the CDO portfolio at the same time. CDOs could potentially be more prone to systemic risk than other investments due to a host of reasons such as trading limitations arising primarily out of their status as a structured vehicle (with limited financial and management flexibility) (Barclays, 2002).

[6] Protection is achieved by the sale of assets which the asset manager perceives to be more risky or which have suffered a down grade by one of the rating agencies. By selling these assets and reinvesting in more secure collateral, the asset manager provides additional security to the rated note holders.

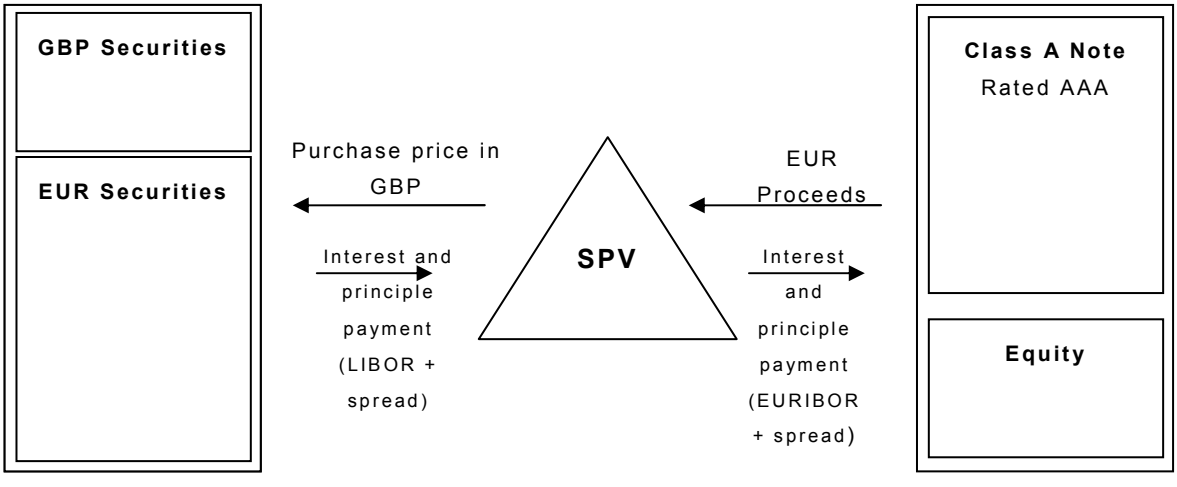
3.2.9. Currency risk or Foreign Exchange risk

To increase the diversity of the collateral portfolio, or to ensure that sufficient investment opportunities in a specific class of asset are available, the asset managers are often motivated to include assets from various domiciles. For instance, asset managers in Europe have periodically invested in assets that are denominated in currencies other than the Euro. Likewise, asset managers in Great Britain have achieved diversification benefits by investing in non-Sterling denominated assets. Diversification (should) lowers the number of common factors between the assets and thereby reduces the exposure to a particular event (Standard & Poor's, 2002).
But while geographic spread reduces the dependency on a specific country or economic region, it introduces the CDO investors to the additional risk that results from uncertainties with respect to future foreign exchange rates (Choi, Le Hénaff, 2005).

A foreign exchange rate (FX rate) measures the value of a foreign currency in terms of one unit of the domestic currency. For example, the EUR/GBP ratio indicates the Sterling amount needed to buy (or sell) one Euro. Since currencies are actively traded instruments, mainly to facilitate international trade, their relative values will fluctuate over time. If the EUR/GBP FX rate increases, the Sterling is said to have depreciated (and the Euro to have appreciated). On the contrary, if the EUR/GBP FX rate decreases, the Sterling is considered to have appreciated (and the Euro to have depreciated).

A simple example might be enlightening. Let's consider a simple CDO structure where some of the assets are denominated in Sterling, while the remainder of the assets are denominated in Euros. The notes issued by the CDO are exclusively denominated in Euros (Figure 3-1).

Figure 3-1: CDO with proceeds denoted in a foreign currency



In this example, the CDO investor is exposed to foreign exchange rate risk since the future FX rates used for converting foreign (Sterling) currency cash flows into domestic

(EUR) currency cash flows at each future measurement and payment date are not known with certainty as of today. In the case of a depreciating Sterling, the EUR received in exchange for the cash flows resulting from the Sterling-denominated CDO assets will be lower than under the current FX rate. This potential risk needs to be assessed and adequately hedged such that it fits the investors risk appetite or rating agencies constrains.

3.3. Hedging foreign exchange risk

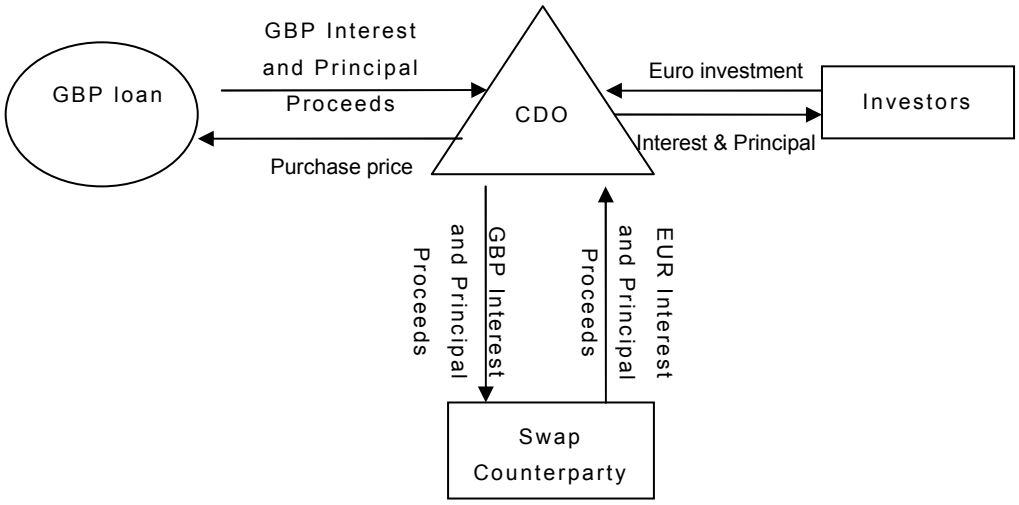
There are several ways to hedge currency risks within a CDO. The first method is an asset specific swap that takes away all currency risk from that specific asset. The second method is a macro hedge that hedges most of the currency risk of the portfolio. Optionality in the macro hedge is very important, but expensive, and even with options there is still a certain amount of unhedged exposure. A third method is a natural hedge that relates the FX exposure of the liabilities to the FX exposure of the assets; this can be achieved by using a multi-currency revolver (NIBC, 2006). All of these methods will be described shortly. Note that in CDO transactions the various structures could be combined and tailored to the specific risk and return requirements of the issuer and potential investors.

In the examples provided in the text below it is assumed that the defaults occur within the pool of foreign (not-base) currency assets. Obviously, the same principles could be applied with regard to defaults in the Euro denominated assets.

3.3.1. Asset specific swaps

Asset specific swaps can be done for each individual asset that is denominated in a foreign currency. In general, the asset specific swap insulates the CDO from any foreign currency movement under most circumstances – whether the asset performs, defaults or prepays (Choi & Le Hénaff, 2005). Obviously, the more protection is provided under the swap agreement, the higher the swap's price. An example of an asset swap is depictured in figure 2-2. A more detailed explanation of the mechanics of an asset swap is included in the appendix, A1.

Figure 3.2: Asset specific swap used by a CDO



In this example the CDO uses an individual swap to exchange the GBP proceeds, received from each individual asset, for Euro. These Euros are subsequently used to fulfil its Euro denominated liabilities.

A commonly used form of the asset specific swap is the perfect asset swap (PAS) which is typically structured with an optionality to cancel and to accelerate at no cost if an asset defaults, prepays (full or partial) or matures during the life time of the transaction (Choi & Le Hénaff, 2005 & Dresdner Kleinwort, 2008-1). If the foreign asset defaults, the asset manager uses the acceleration option for an amount equal to the expected recovery value and the cancellation option is exercised for an amount equal to the loss. The acceleration option allows for a quick repayment of the recovery value of the defaulted asset, while the cancellation option ensures that no further interest payments are made after a default (NIBC, 2006).

Most asset specific swaps allow for an early termination in case the asset manager wants to sell the reference asset. As the asset specific swap is specifically tailored to the reference asset, the swap has to be terminated as a consequence of a sell of the reference asset. To terminate the swap, the asset manager will have to incur (or receive) a termination payment depending on the FX rate change since the swap was initiated. The termination fee and the cost associated with a renewal of the swap agreement are therefore important factors to be considered in the reinvestment process.

Advantages of an asset specific swap

1. The asset specific swap totally eliminates currency risk (except of course unhedged exposure).
2. The structure of the deal is still very clear to investors.

Disadvantages

1. In case of a default of collateral under such a contract, asset recovery must typically take place within one year. This will probably decrease recovery rates.
2. Selling collateral will result in terminating the contract inducing termination cost. This will restrain the manager in trading the asset.
3. It might prove hard to unwind the swap in case of a call of the equity investors[7].
4. The ASS introduces additional counterparty risk into the transaction (versus the swap counter party).
5. In the current market environment swaps are relatively expensive and hard to obtain.
6. There are substantial costs incurred to obtain and maintain the swap.

Conclusion

When perfect asset swaps are used in the CDO all currency risk is eliminated from the structure. Unfortunately asset specific swaps are currently quite hard to obtain and relatively expensive.

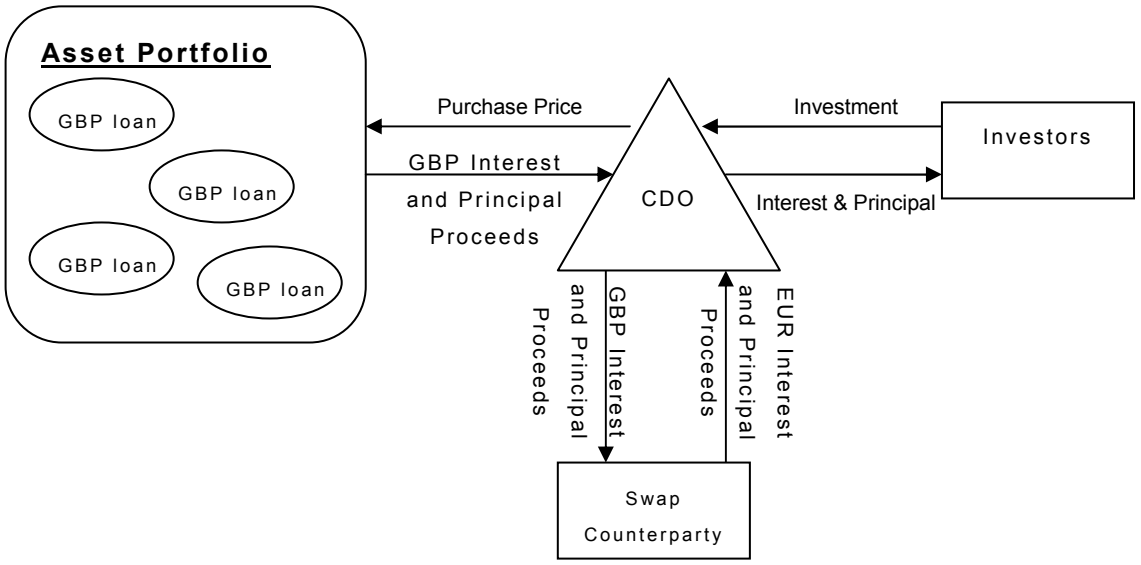
[7] Many CDOs are structured with a Call or optional redemption feature. This feature allows the junior note holders to call the transaction given that certain pre-specified conditions are met. Upon such a request the Issuer shall unwind the transaction and use the proceeds to redeem the CDO's liabilities.

3.3.2. Macro hedge

To offset some of the drawbacks of asset specific swaps, an asset manager or issuer could opt for a macro hedge (NIBC, 2006). Macro hedges are hedges done on portfolio level. Thereby these hedges attempt to mitigate the possible expense related to reinvestments; the swaps and options are not related to a specific reference and therefore termination is not a necessity during the reinvestment period. However, macro hedges usually do not cover the entire currency risk, but, should be robust enough to limit additional losses to the rated note holders (Choi & Le Hénaff, 2005).

To create a macro hedge it is necessary to enter into two swap contracts: 1) first a swap on the notional value of the foreign currency - this is a quanto swap that eliminates the foreign interest rate risk and foreign exchange risk on the notional - and; 2) an additional swap to hedge the excess spread (NIBC, 2006).

Figure 3-3: Macro hedge on an asset portfolio



The macro-swap with the swap-counterparty exchanges the payments received from the assets portfolio from GBP to Euro.

Both swaps need to be augmented with acceleration and cancellation options. The acceleration option allows costless termination of (part of) the swap contract with exchange of principal. This option is exercised in case of a prepayment or recovery that is not reinvested in the foreign currency. To minimise the costs of the swaptions both swaps have an amortising profile (Dresdner Kleinwort, 2008-1). Cancellation options allow for early termination of the contract without exchange of principal. Such options can be used in case of a default to cancel the contract for the part of the loss (Choi & Le Hénaff, 2005).

Timing issues evolve when there is a collateral default. When the options are excised immediately, the acceleration options need to be exercised for the expected recovery and the cancellation options for the expected loss (Dresdner Kleinwort, 2008-1). However, there is a currency risk on the mismatch between the expectation and the actual recovery. When the options are exercised at the time of recovery the options are exercised optimally with respect to loss and recovery, however interest payments to the swap in the foreign currency are no longer covered by the proceeds of the assets and introduce additional FX risk (NIBC, 2006 & Dresdner Kleinwort, 2008-1).
A possible solution to this problem is to choose to exercise at time of recovery and to buy out of the money FX options (at strike 120%, which are cheaper than at the money options) to service the interest payments on the swap at the intermediate period (NIBC, 2006).

It is also important that prepayments and recoveries are immediately reinvested in the same currency in order not to over hedge the interest payments.

Rating agencies will use extreme stresses on defaults, recoveries, prepayments, interest rate and FX curves to evaluate the effectiveness of the macro hedge. This can result in structures with reduced leverage and consequently lower returns on equity (NIBC, 2009).

Advantages

1. Macro hedges probably have a small cost advantage to perfect asset swaps;
2. Offer the possibility to trade assets in the foreign currency; and
3. Are less vulnerable to unevenly distributed prepayments (after the reinvestment period) in the different currencies than the natural hedge.

Disadvantages

1. It may be hard to loosen the macro swap if the pool of investments in a certain country dries out and it would be better to invest in other currencies (this depends on the possibility to exercise the options in the swap).
2. For the same reason it may be hard to unwind the swap in case of a call of the equity investors.
3. Rating agency stresses may have big influence on the capital structure.
4. In the current market environment swaps are relatively expensive and hard to obtain.

Conclusion

The macro hedge provides an alternative solution for the hedging of currency risk. The costs of this structure are generally lower than those of a perfect asset swap and the structure obtains increased flexibility. The increased flexibility and lower cost come with increased risk as the macro hedge is generally not perfect.
Rating agencies will use extreme stresses to test the weaknesses of the structure. A macro hedge may have a negative result on the tranching compared to perfect hedges.

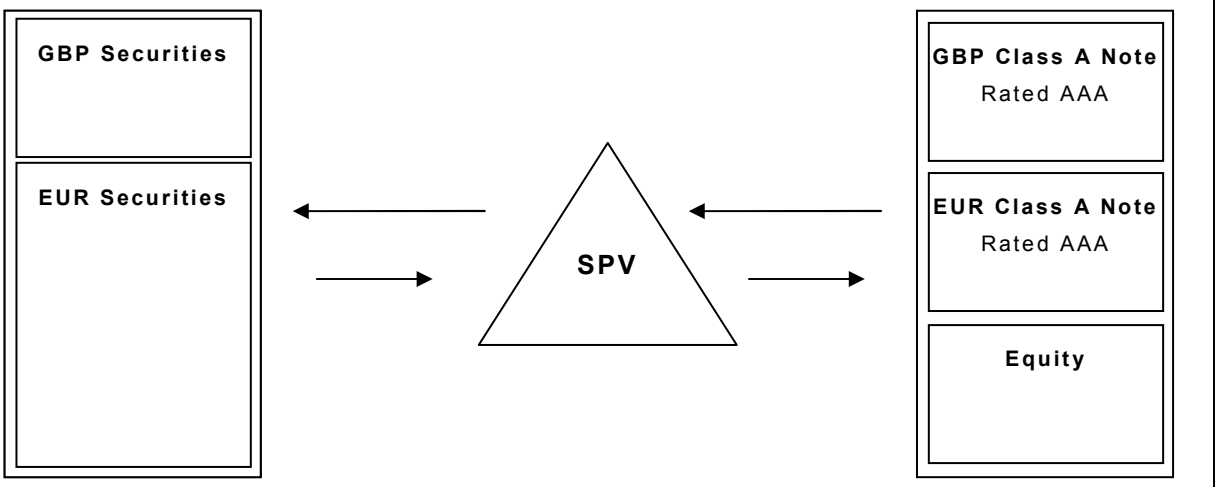
3.3.3. Natural hedge using a foreign denominated term note

A third way to hedge foreign currency exposure is natural hedging. Natural hedging includes the issuance of notes in foreign currency to attract funding for the foreign denominated assets. Payments and notional on the notes issued in the distinct currencies should cover for the CDOs liability.

Even though natural hedging mitigates the need for (specific) asset swaps, there is still a risk on the spread and a foreign exchange rate risk should an asset default. These risks are easiest explained using an example (NIBC, 2006).

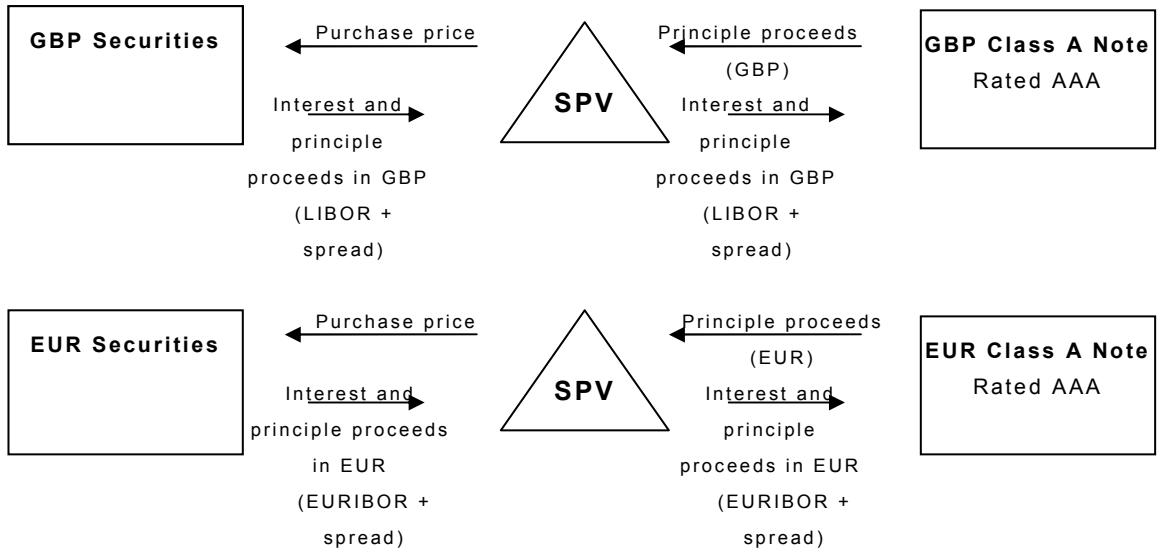
For simplicity's sake, assume that we are dealing with a naturally hedged Euro denominated CDO which issued notes in GBP to hedge its expose to GBP denominated liabilities (Figure).

Figure 3-4: Natural Hedged CDO



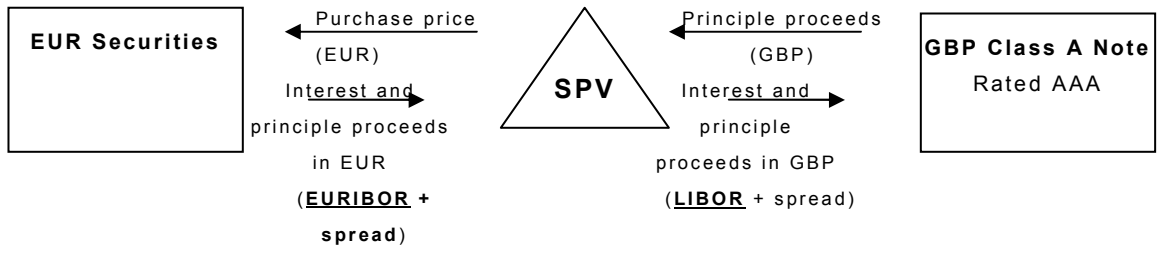
In absence of a default, the proceeds from the investments will be used to pay the note holders on a like-for-like basis (e.g. the GBP proceeds will be used to pay for the GBP liabilities and the Euro proceeds will be used to pay for the Euro liabilities) (Offering Circulars, 2006-2007).

Figure 3-5: Natural Hedge, structure pays like-for-like



In case of a default among the GBP assets, the GBP proceeds might no longer suffice to pay for the GBP liabilities. To cure the mismatch in GBP, the CDO will have to use its Euro proceeds to cover its GBP liabilities. The conversion of Euro exposes the CDO to both FX and interest rate risk as the Euro interest proceeds are received usually at EURIBOR + spread, while the interest on GBP liabilities will have to be paid against LIBOR + spread (Figure).[8]

Figure 3-6: Foreign exchange mismatch



If the size of the default is severe enough to trigger the overcollateralisation test, the asset manager will have to start to redeem the senior notes denominated in GBP until the test is brought back into compliance. The redemption of the notes is usually funded with principle proceeds denominated in the CDO's base currency. In our example the asset manager will have to exchange Euro to GBP at the time of the default to redeem the GBP

[8] Here it is assumed that both the assets and liabilities are paid based on a floating interest rate. Naturally this risk would be absent when both the assets and the liabilities were paid based on a fixed rate.

notes. Early redemption of the GBP notes cures the EURIBOR - LIBOR mismatch, however, it exposes the CDO to a change in the foreign exchange rate during the time that the GBP notes are redeemed and the time at which potential recoveries on the defaulted asset are obtained.

To reduce the potential loss resulting from foreign exchange exposure, existing CDOs have included extra hedges or FX-reserve accounts in their structures. For example, Harbourmaster[9] introduced a structure in which at the time when a GBP asset defaults, the liability corresponding to the defaulted amount (net of "expected recoveries") is immediately converted/redenominated to Euro to minimise the FX exposure on the expected loss. Foreign exchange (quanto-) options (with a maturity of 2 years and a slightly out-of-the-money strike price) are purchased at the time of default and will be used to redenominate the GBP liabilities that correspond to unrecovered "expected recoveries". The quanto-options hedge the foreign exchange exposure which would result from the timing mismatch between the time of default and the time of the recovery (Habourmaster Pro-Rata CLO 2, 2006).

Rating agencies will use simulations to evaluate the effectiveness of the hedge. In general the rating agencies will significantly bias the probability of default towards the foreign denominated assets to test the structures resistance to foreign exchange risks (NIBC, 2009).

Advantages

1. This structure appears to be more cost efficient as no termination payments on swaps are called for.
2. Increased flexibility in trading assets in foreign currencies; however the asset mix needs to represent the liability mix.
3. Less counterparty risk due to the absence of a swap agreement.
4. Less documentation and operational risk.

Disadvantages

1. It may be hard to find investors in the notes in foreign currencies.
2. When there are defaults in the foreign currency assets, there is a reverse FX risk. This risk can be mitigated by entering into option contracts; however the effectiveness of these options relies on the quality and prudence of the collateral manager.

Conclusion

Natural hedges provide an alternative to swap hedges. In case of defaults this type of hedging can cause large FX risks. Therefore it is advisable to purchase quanto options or have an FX reserve account. This account is usually funded at the closing of the transaction from the proceeds of the selling of the notes. In most deals the manager has

[9] This is the structure proposed by Harbourmaster in the Harbourmaster Pro-Rata CLO 2 B.V.

significant flexibility to pay this account to equity holders. It is important to investigate the effect of this structure to the tranching.

3.3.4. (Natural) Hedging using a Revolving multi-currency facility

A variant to the natural hedge is a revolving credit facility (RCF) in the same currency as the foreign currency denominated assets. This facility will be used to draw from or will be (partially) redeemed in order to maintain the appropriate balance between foreign denominated assets and liabilities of the structure. Using a revolving or variable funding note (VFN), which are basically different names for the same instrument, would solve the problems which naturally hedged transactions face with regards to (p)repayments. At the time of a (p)repayment, the received proceeds are used to partially redeem the revolving facility. In addition, using a multi-currency revolving note provides the asset manager with the opportunity to (re)invest in different currencies, as the spread and exchange risk is hedged by the revolving instrument (Dresdner Kleinwort, 2008-2). Unfortunately, this type of structure does not resolve the risk related to the spread and FX, should a default occur (NIBC, 2006).

Revolving facilities or notes derive their properties from the revolving loans. These loans allow the borrowing party to delay a drawdown until an opportunity presents itself (or until the borrowing party requires additional liquidity). The borrowing party is at liberty to redeem any amount borrowed or to borrow additional money up until the agreed limit and before the loan reaches maturity. The size of the drawdown and the drawdown dates are subjected to the loan documentation accompanying the loan (presumably standard loan market association (LMA)). Before the first drawdown the loan is said to be unfunded (from the issuing bank's perspective) and the borrower pays a small fee, a commitment fee, to the lenders for the availability of the facility. After the first drawdown (and before full redemption) the loan is said to be partially funded and the borrowing party will pay EURIBOR/LIBOR + the agreed spread on the drawn part + fee on the remaining undrawn amount. (The base rate is defined in the loan documentation).

The hedging properties of the revolving note are best explained using a simplified example. (Please note that the proposed structure will only cover one of the many hedging structures available and used in practise). The example will elaborate on the CDO-structure which was introduced in section 3.2.9. However, this time the SPV did not only issue Euro denominated notes, but also a multi-currency revolver (Figure 3-17).

As long as the assets are performing, the revolver could remain (partially) undrawn and the note holder is paid a small fee. Similar to the naturally hedged structure, the asset manager has to redeem part of the GBP notes at the time of a default among the GBP assets. This is where the two structures differ. Instead of using the Euro principle proceeds to redeem the amount equal to the defaulted asset, as was done under the natural hedging structure, the asset manager has to estimate the expected loss and only uses the Euro proceeds to redeem this part of the GBP denominated notes. The

remainder, equal to the expected recovery, is withdrawn in Euro from the revolving note and used to redeem the remaining GBP notes at the then prevailing spot-rate such that the Currency mismatch test is brought back into compliance (Offering Circulars, 2006-2007 and Dresdner Kleinwort, 2008-2).
The recoveries on the defaulted GBP denominated assets are at a later stage used to redeem the multi-currency notes, which were drawn in Euro. To hedge the remaining FX-risk the collateral manager purchases American Options, which create a minimum GBP/Euro exchange rate.

The revolving notes are generally structured such that they obtain a AAA-rating from the rating agencies. The main benefits of a AAA-rating is the lower costs associated with this facility, especially when it remains undrawn.
In many existing structures extra OC tests have to be implemented to service the revolver. These coverage tests resemble the OC in case of a natural hedge (Offering Circulars, 2006-2007).

Figure 3-7: Naturally Hedged CDO

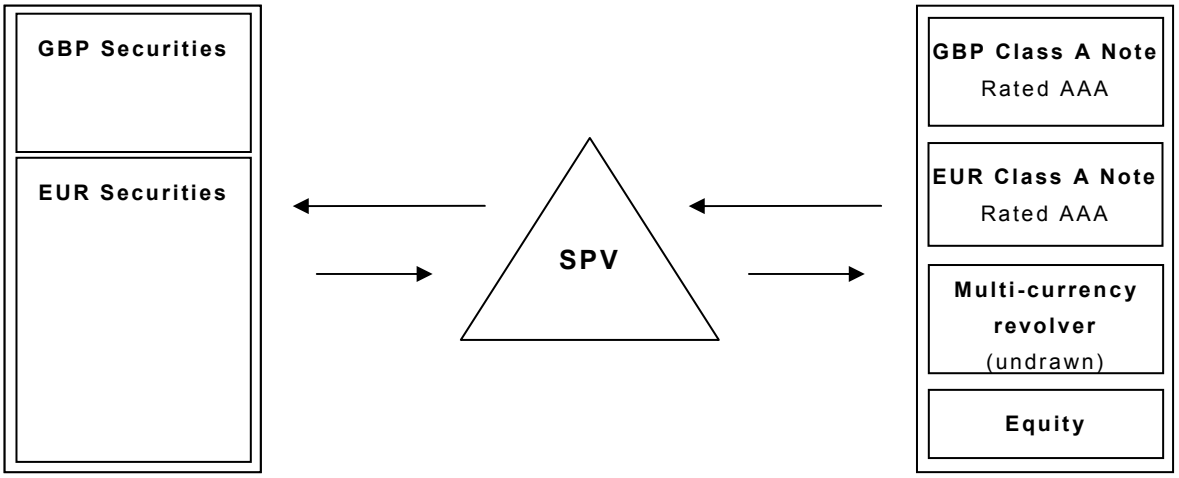


Figure 3-1a: The original multi-currency CDO including a revolving note. The assets are currently performing (e.g. no defaults have yet occurred). The assets pay on a like-for-like basis for the liabilities of the SPV.

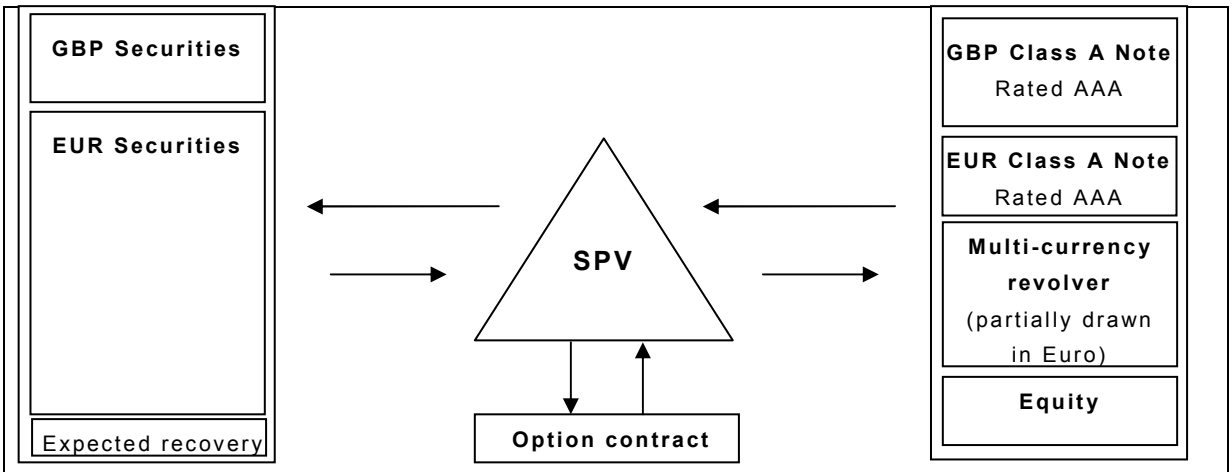


Figure 3-7b: The same multi-currency CDO at the time of a default. A default has occurred in the GBP denominated assets. The value of the GBP assets has been reduced by the loss resulting from the default. To cure the OC-test, the asset manager has drawn Euros from the multi-currency revolver, exchanged these Euros at the then prevailing spot rate for GBP and redeemed part of the GBP notes (notice that the size of the GBP-notes has been decreased). The asset manager purchases slightly out of the money American options to hedge the volatility in value the expected recovery. These options hedge most of the foreign exchange risk related to the possibility that the actual recovery, denominated in Euros, is lower than the expected recovery in Euros (Dresdner Kleinwort, 2008-2).

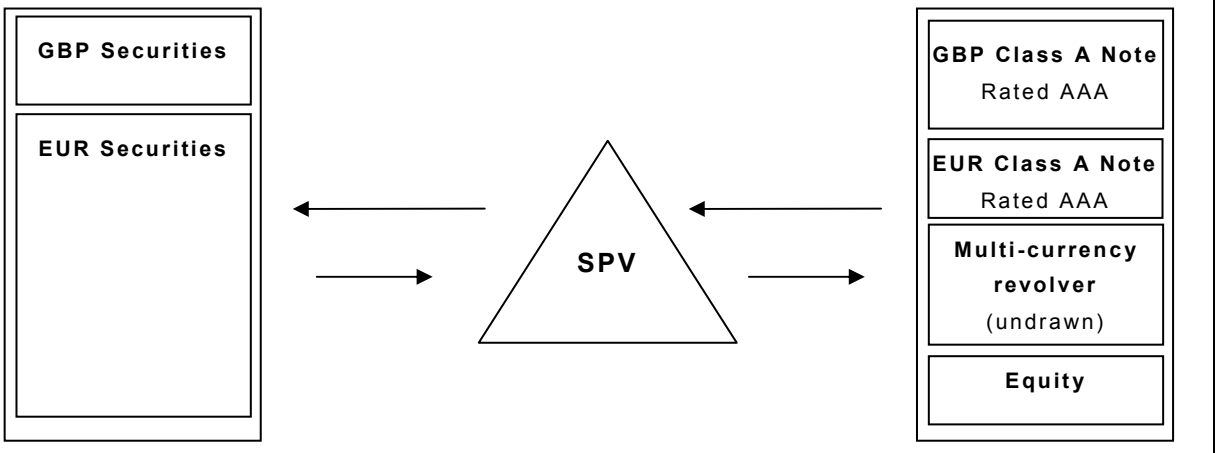


Figure 3-7c: The recoveries of the default are used to redeem the amount drawn on the multi-currency revolver. The asset manager will exercise the purchased options when they are in the money. Without these options the recovered amount would be (substantially) lower than the expected recovery due to a Sterling depreciation.

The example in figure 3.7 explained the mechanics of a hedging strategy of a naturally hedged CDO using a like-for-like structure. Lately, however, this structure has been substituted for a structure in which the senior rated foreign currencies liabilities need to be repaid pro-rata; that is proportionally (Offering Circulars, 2006-2007). The pro-rate

repayment structure offers investors increased flexibility in asset sourcing and improved access to the loan market (Dresdner Kleinwort, 2008-2).
Similar to a like-for-like structure, the payments and notional on the assets should cover the liabilities at the outset. However, the pro-rate repayment structure faces a possible problem when the foreign denominated assets amortise slower than their Euro denominated counterparts. The received repayments would have to be distributed between the pari-passu ranking notes. This would introduce an FX-mismatch as the redemptions on the assets in the different currencies will most probably not be in the same proportion as the senior notes and proceeds in one currency would have to be converted to the other currency to repay the notes pro-rata (NIBC, 2009).
To mitigate this potential problem, the structure usually includes a profile test which ensures that the maturity of the foreign denominated assets is lower than that of the Euro assets. In addition, many structures add into the priority of payments a specific clause which introduces a like-for-like structure to the most senior rated notes, but which leaves repayment of the rest of the structure pro-rata (Dresdner Kleinwort, 2008-2).

Advantages

1. This is probably the most cost efficient as there are no termination payments on swaps and the foreign exchange risk is minimised.
2. This structure allows for an increased flexibility in trading assets in foreign currencies relative to the natural hedge and the macro hedge structures. The size of the foreign currency pool is more flexible due to the possibility of additional draw down and partial redemption of the Revolving Facility.
3. Limited counterparty.
4. Prepayment rate does not matter, as long as it is evenly spread across all currencies.
5. Less documentation and operational risk.

Disadvantages

1. It may be hard to find investors in the notes. The senior note investor must have a minimum rating, to ensure that the committed funds are available for draw downs.
2. There is a commitment fee payable to the Revolving Facility investor, which introduces negative carry in case of partial or no draw down of the facility.
3. When there are defaults in the foreign currency assets, there is a reverse FX risk. This risk can be mitigated by entering into option contracts; however, the effectiveness of the hedge depends on the strategy of the collateral manager.

Conclusion

Many of the advantages to the natural hedge also apply to the revolver. In addition the multi-currency revolver provides a flexible hedge for a part of the currency risk in the structure. In case of defaults this type of hedging can cause large FX risks; therefore transactions using this type of hedging have prefunded reserves for purchasing FX options.

3.4. Conclusion

In this chapter the main risks related to investments in CDOs were discussed. The issuer of a CDO cleverly applies diversification techniques to reduce the asset specific exposures and thereby alleviates the potential consequences of these risks. But unlike most risks, the risk related to foreign exchange is usually not increased by diversification. This is mainly due to the fact that in order to improve diversification, the CDO issuer acquires assets from different domiciles and thereby assumes additional multi-currency risk.
To hedge the foreign exchange risk, CDOs often apply any of the four hedging methodologies described in section 3.3: Asset swaps, portfolio swaps, natural hedges and variable funding notes.

There are four points to consider when choosing the appropriate hedge:

1. Costs of hedging;
2. Remaining currency risk and the effect on the capital structure;
3. Flexibility of the manager to trade foreign securities; and
4. Clarity to investors

The choice for a specific hedging strategy is mostly a trade off between the effects on the capital structure and the flexibility to the manager. Rated note holders will look for the option which provides maximum protection for their investment. Equity investors will probably appreciate the qualities of the manager and therefore be willing to grant the manager more flexibility to increase returns where rated notes investors will want a minimum of FX risk.

Perfect asset swaps might be preferred by rated note holders. These instruments provide a perfect hedge and transparency for the rated note holders; however they come at a relatively high price and provide limited flexibility. In addition recent market turmoil and rating downgrades of potential swap counterparties have both limited the availability and increased the price of these instruments.
Naturally hedged transactions including multi-currency revolvers might be an interesting alternative. These instruments provide significantly more flexibility than the (perfect) asset swaps, while still providing much of the protection sought by rated note investors. In addition, the limited costs related to the inclusion of a multi-currency revolver allow the issuer to increase the potential benefits of the CDO structure.

To achieve a better understanding of multi-currency revolvers and its current applications, different CDO-structures which have used multi-currency revolvers will be reviewed in the next chapter.

4. Currency Hedges as practised in the market

4.1. Introduction

By studying the CLOs issued between January 2006 and June 2007, the evolution and different applications of a VFN in a multi-currency CLO will be reviewed in this chapter. In so doing, an answer will be provided to the third and fourth research questions:

1) *What kind of hedging structures are currently being or have been employed in CDOs which include multi-currency revolvers?*

2) *What is the impact of implementing these hedging structures in our base case model? And how should these structures be compared?*

The market for CLOs during the specified period will be shortly described in section 4.2. This description is followed by an overview of the various hedging structures which are regularly encountered in the CLO market in section 4.3. The consequences of incorporating their structural features into a CLO structure will be discussed in the second part of the same section and will contribute to the creation of 8 test-structures in section 4.4. To allow for the evaluation of these distinct hedging structures, the criteria for comparison will finally be established in section 4.5.

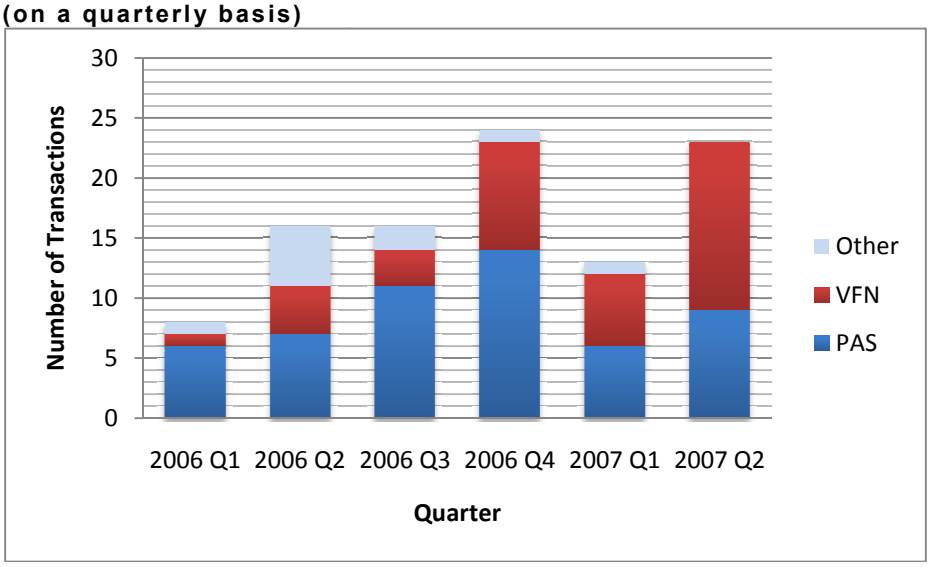
4.2. The introduction of the VFN

CLO-issuers can and do modify the structure of their transactions as they see fit. Creative issuers use innovative new concepts (such as a VFN), implement all kinds of cash flow tricks and include a multitude of contracts for credit derivatives in their attempt to squeeze the last penny out of the newly created CLO structure (Tavakoli, 2009). The sole limitations to these new innovations and modifications are the requirements set by rating agencies and the investor community's appetite for a given product.
The tables presented in appendix A2 provide an overview of the European CDOs of Leveraged Loans, which were rated by Standard & Poor in the period starting with the first quarter of 2006 and ending in the second quarter of 2007 with the start of financial crisis. These types of CDOs are called a collateralised loan obligation (CLO), i.e. the securitisation of corporate and sovereign loans (Eck, 1998; Kohler, 1998).
During this period we have witnessed impressive economic growth and a surge in the CLO market; with 64 S&P-rated CLO transactions closed in 2006, more than in the previous 5 years combined. Even though the third quarter of 2007 still showed a large number of CLO closing (mainly transactions which were initiated prior to the credit crunch), this period is excluded from this overview as since then no further significant innovations have taken place with regards to the hedging of currency risk (Offering Circulars, 2006-2007).

Between January 2006 and June 2007 most European CLOs held loans denominated in more than one currency: typically the CLOs invested in loans denominated in British

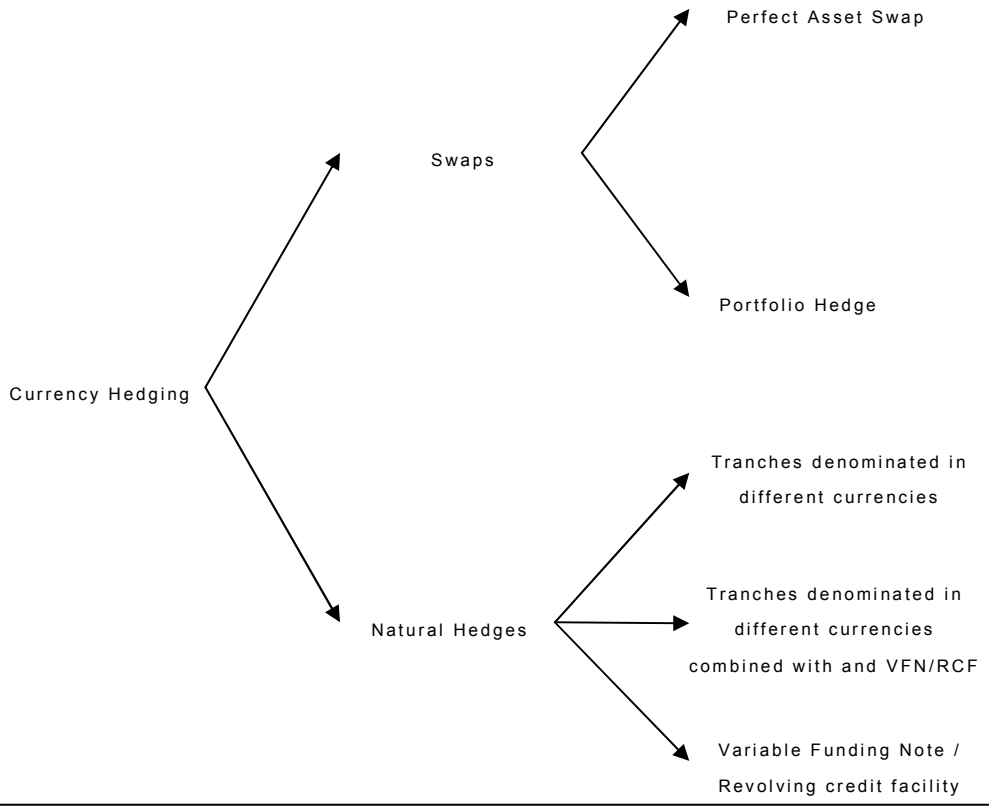
pounds Sterling, U.S. dollar, and Euro. The traditional way in which managers addressed currency risk in CLOs was by using asset-specific hedges on each non-Euro loan.
An analysis of the various multi-currency hedging techniques used in the CLOs issued during this period shows a gradual transition from multi-currency risk hedging based on perfect asset swaps, mainly in the beginning 2006, towards the somewhat more involving techniques based on a VFN combined with options, during the second half of 2006 onwards, figure 4-1.

Figure 4-1: Division of hedging strategy used in recently launched CLO transactions (on a quarterly basis)



The timing of this transition is somewhat remarkable given that the variable funding note was first introduced to the European CLO market in 2003 by JPMorgan and ING in the Copernicus Euro II B.V. CLO (www.securitizability.com, 2003) and the relative transparency of the CLO/CDO market. This transparency consisted mainly in the fact that most offering circulars, the documents stipulating the mechanics of a CLO, are available free of cost or at a limited price. The availability of this type of information should have allowed market participants to quickly pick up on any major innovation, duplicate the innovative structure and, provided that innovation is beneficial to the structure, use it in its own transactions. Based on the slow adoption of the variable funding notes in the CLO structures, it seems that certain external conditions prevented its breakthrough. Probably these factors related to the relative higher cost compared to the more conventional techniques and low demand for variable funding notes among investors.
This situation apparently changed during the summer of 2006 and the start of 2007, when the spreads on senior rated notes hit their all-time lows. Plausibly this reduction in the relative cost and the increase in flexibility offered by this technique were sufficiently to make CLO issuers adopt the VFN. Interestingly, even during this period the demand from investors for this instrument remained low, requiring most issuers to retain the VFN in their own books.

Figure 4-2: Key elements of the currency hedging structures applied in the market between January 2006 and June 2007



4.3. The structures

The tree diagram (Figure 4-2) makes a distinction between those transactions which apply swaps and those who apply natural hedges to hedge the currency risk.

The rationale behind both hedging structures was explained in chapter 3. Asset specific or portfolio swaps mitigate currency risk by exchanging the cash flows obtained from foreign denominated asset to the base currency of the structure. Thereby the PAS basically reduces the multi-currency structure to a single currency structure.

In contrast, the multi-currency cash flows pass through the structure from the assets to the notes in the natural hedged transactions. Natural hedged transactions hedge currency risk by issuing notes in multiple currencies, in order to match the assets in the portfolio to the liabilities. These distinctions have a profound impact on the priority of payments of the transaction and thereby the way in which it has to be structured.

The following section will outline a simple multi-currency structure, as it is found in many CLO transactions. The subsequent section will build upon this foundation and discuss the main structural differences of a multi-currency structure including a variable funding note. ***All the information provided in these sections is based on a review of the offering circulars 2006-2007 and an analysis of the tables included in appendix A3, A4 and A5***.

4.3.1. The multi-currency CLO structure

The European CLOs rated by S&P, and reviewed in the previous section, are all cash flow structures for which the underlying assets consist of leveraged loans. Cash flow structures are those in which the underlying assets themselves, not the total return generated from active management of the portfolio, are the primary source of repayment of the liabilities (Tavakoli, 2008).

In order to structure a CLO the arranger (or structure) goes through the steps as outlined in chapter 2: a structure is created, a collateral manager is appointed and assets are warehoused. After the warehousing period, the proposed structure is rated by the rating agencies and the special purpose vehicle issues the notes to fund the purchase of the assets, the leveraged loans.
In general the SPV will be structured as a pay-through structure, which allows for periodic reinvestment or substitution of a predetermined percentage of the asset portfolio. Reinvestments are typically allowed during the first 5 years of a cash flow deal, for as long as the structure complies with reinvestment test specified in the indenture (Tavakoli, 2008).

The choice for a natural hedge to mitigate currency risk requires that the SPV issues notes in several currencies, most commonly two. In most transactions currency risk emanating from assets denominated in currencies other than the currencies of the notes, is mitigated by using perfect assets swaps.
The basic idea behind the multi-currency structure was outlined in section 3.3.3. In addition to the duo currency structure, many transactions include either a multi-currency revolver or variable funding note. Others replace the duo currency structure altogether and only include a multi-currency instrument. This section will discuss a duo-currency structure including a revolving instrument and provide a comprehensive overview of the various options and the ramifications of the chosen structure.

Table 4-1 shows a basic tranching for a natural hedged multi-currency CLO including a multi-currency revolving credit facility. In most transactions the size of the tranches denominated in the base currency will outweigh the ones denominated in the foreign currency. The example used in this section will use a ratio of 80% Euro and 20% Sterling denominated liabilities. In addition the size of the MCR will be limited to 10% of the notional value of the assets.

Table 4-1: Basic example of the tranching in a multi-currency CLO

Multi-currency cash CLO			
Grade	**Rating**	**Tranche size***	**Percentage of Portfolio**
VFN/RCF	Aaa	€ 70,000,000.00	10.0%
Class-A1	Aaa	€ 633,200,000.00	63.32%
Class-A2	Aaa	£ 146,500,000.00	14.65%
Class-B1	Aa2	€ 18,400,000.00	1.84%
Class-B2	Aa2	£ 3,833,333.33	0.38%
Class-C1	Baa2	€ 22,400,000.00	2.24%
Class-C2	Baa2	£ 4,666,666.67	0.47%
Equity		€ 70,000,000.00	7.0%
		€ 1,000,000,000.00	100.0%

* The tranche size is determined based on a 1.20 EUR/GBP exchange rate

The interest waterfall

The interest waterfall of a multi-currency structure looks largely similar to the waterfall of a single currency structure, except that the interest proceeds consist of both Euros and Sterling. All interest proceeds received from the assets, reduced with the costs related to fees and hedging agreements, are usually sequentially distributed to the note holders and equity investors in agreement with the transaction's interest waterfall, Figure 4-4.

Hence after the senior costs, the most senior note holders should receive their entitled interest. Notice that Table 4-1 includes two class-A Aaa rated tranches: the class-A1 notes denominated in Euro and the class-A2 notes denominated in Sterling. The fact that both tranches received the same rating from the rating agencies does by itself not indicate their relative seniority. Provided that sufficient subordination and/or hedges are provided a transaction could include many Aaa rated tranches. The seniority of the tranches is anchored in the transaction's documentation, according to the structure's intent.

In many transactions which include a duo-currency structure, the two class-A tranches are pari-passu, meaning that they have the same level of seniority and will receive their entitled interest simultaneously. These interest proceeds will usually be distributed to the two class-A tranches on a like-for-like and pro-rate basis; the two classes will receive a relative portion of the available interest proceeds, where, to the extent that there are sufficient interest proceeds in a respective currency, these proceeds will be use to satisfy the liabilities in the same currency. In case of a shortfall of interest proceeds in either of the two currencies, and in absence of a breach of any of the triggers, this shortfall is usually cured by converting either Euro to Sterling or Sterling to Euro at spot. However, the arranger could have chosen for a structure which fixes the exchange rate at closing. If the interest proceeds are insufficient to cover the shortfall, this respective shortfall will be proportionally borne by the pari-passu ranking tranches with the same seniority.

In other transactions a strict like-for-like payment of the interest proceeds is maintained. In effect this transaction has two distinct waterfalls for each of the currencies after paying the senior fees and expenses. A shortfall in either of the currencies will not be cured by converting interest proceeds into the other currency until the pari-passu ranking liabilities in the respective currency have been serviced.

The principle proceeds waterfall

Analogue to the interest waterfall, the principle proceeds waterfall will have been adjusted to manage the duo currency structure. In most transactions the notes are paid sequentially starting with the most senior note. Notes with the same level of seniority are usually pari-passu. However, in some transactions a strict like-for-like basis is maintained throughout the structure and shortfalls in either currency are not cured by exchanging principle proceeds into the other currency before the pari-passu ranking notes are redeemed in full.

If the notes are pari-passu, the principle proceeds will either be allotted on a pro-rata and/or like-for-like basis to the pari-passu raking notes, to the extent that no trigger is breached. If on the payment date the issuer determines that there is an insufficient amount of either Euro or Sterling proceeds, this shortfall is usually cured at spot by exchanging either the Euro-equivalent of the Sterling shortfall to Sterling or a Sterling-equivalent of the Euro shortfall to Euro. If the principle proceeds are insufficient to cure the shortfall, this shortfall will be proportionally borne by the pari-passu ranking tranches with the same seniority.

Figure 4-5 displays the principle proceeds waterfall for the tranched structure used as an example in this section.

Coverage tests

Both the interest and the principle proceeds waterfall of the duo currency structure incorporate a coverage tests, which have to be passed before any interest or principle is distributed to the next level in the waterfall.

Assuming that the like-for-like structure is not strictly maintained throughout the entire structure, the OC and IC test need to be amended such that the foreign denominated cash flows are converted to the base currency. In most transactions this conversion will be made using the prevailing spot exchange rate.

Please note that the single currency OC and IC test will suffice for a duo currency structure in which a strict like-for-like payment basis is maintained. Given that a distinct test is used for each respective currency.

$$\text{OC Test} = \frac{\text{Total Euro Collateral + Total GBP Collateral (redenominated in Euro) + Cash Reinvestment Accounts}}{\text{Remaining Principle Amount of the Tranches senior to Tranche X (expressed in Euro) + Remaining Principle Amount Tranche X + (expressed in Euro)}}$$

$$\text{IC Test} = \frac{\text{Collateral Interest Proceeds (redenominated in Euro) + receipts from Hedge counterparties}}{\text{Senior Expenses + Hedging Costs + Interest on Tranches Senior to X (expressed in Euro) + Interest on Tranche X (expressed in Euro)}}$$

A breach of either of these tests usually results in a sequential redemption of the notes, until the test is brought back into compliance. The triggers are designed such that the most junior trigger will be the first to be breached in case of deterioration in the quality of the assets. For example, when the quality of the assets of a CLO deteriorates, the coverage test for the Baa2 rated notes in the exemplar tranching in Figure 4-5 will be the first to be breached and trigger a sequential redemption of the most senior rated notes.
The trigger levels for the coverage tests vary from deal to deal and are subjected to the writing in the deal's offer circular. In general the higher the trigger levels the more security is provided to the note holders. An example of trigger levels can be found in Table 4-2

Table 4-2: Example of an overcollateralisation test

Overcollateralisation Tests	Threshold Value
The Class A Overcollateralisation Test	106.0%
The Class B Overcollateralisation Test	103.0%
The Class C Overcollateralisation Test	100.0%

Table 4-3: Example of an interest coverage test

Interest Coverage Tests	Threshold Value
The Class A Interest Coverage Test	110.0%
The Class B Interest Coverage Test	105.0%
The Class C Interest Coverage Test	102.0%

In addition to the OC and IC-tests the structure will be subjected to a number of profile and collateral quality tests. The portfolio profile tests contain limits with regards to the minimum and maximum allowed investments in a specific category of asset, geographic distribution and rating. The collateral quality tests ensure the quality of the consolidated portfolio by measuring among others: the rating of the assets, the diversity, expected recoveries and spreads. The enumeration below includes a non-limitative list of commonly observed portfolio tests:

Selected Portfolio Profile Tests: Second Secured Debt Obligations, Unsecured Debt Obligations, Second Secured Debt Obligations and Unsecured Debt Obligations, Non-Euro Obligations, Structured Finance Securities, Single Obligor Concentration, Annual or longer Coupon Basket, Non-Floating Rate Obligations, Collateral rated Caa1/ CCC+ or

less, Total Participations, Total Synthetic Securities, Total of Participations and Synthetic Securities, Revolving Loans, Tradable Assets (per annum) and Long Dated Basket; and

Selected Collateral Quality Tests related to the: Weighted Average Life, Average Moody's Rating Factor, Diversity Score, Moody's Weighted Average Recovery Rate, S&P's Weighted Average Recovery Rate, Scenario Default Rates and Weighted Average Cash Spread.

Under normal circumstances, when none of the covenants are breached, and given that the transaction is still within its reinvestment period, the collateral administrator will monitor the proposed reinvestments by the collateral manager to ensure that the portfolio will remain within the specified limits.
A breach could therefore only occur due to the deterioration of the quality of the portfolio's collateral. If one or a combination of the covenants are breached this will reduce the collateral manager's ability to reinvest. Commonly the reinvestment potential will be limited to investments which bring the portfolio back into compliance with the breached tests.

Summary

The figure (figure 4-3) below provides a schematic overview of the structures discussed in the previous paragraphs.

Figure 4-3: Summary MCI structures

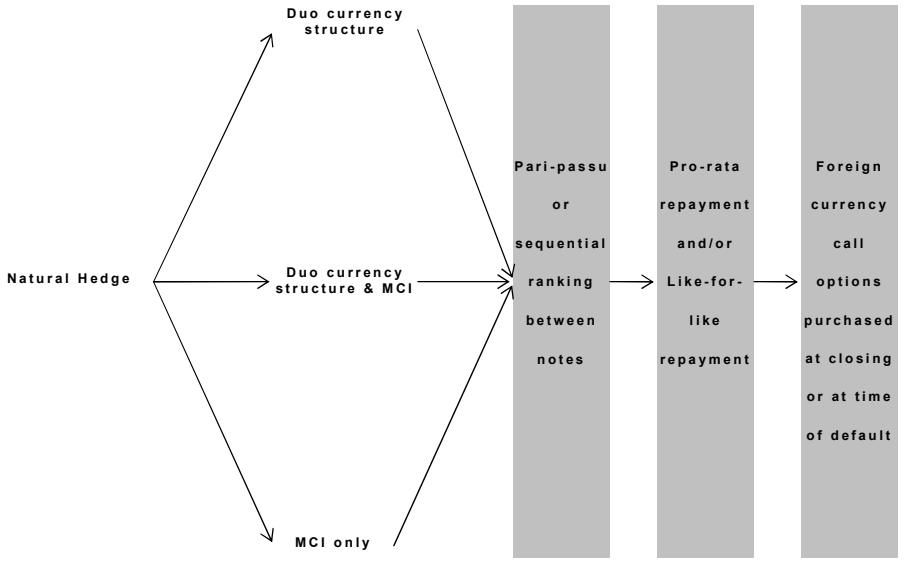


Figure 4-4: Interest proceeds waterfall for a natural hedged transaction including a MCI

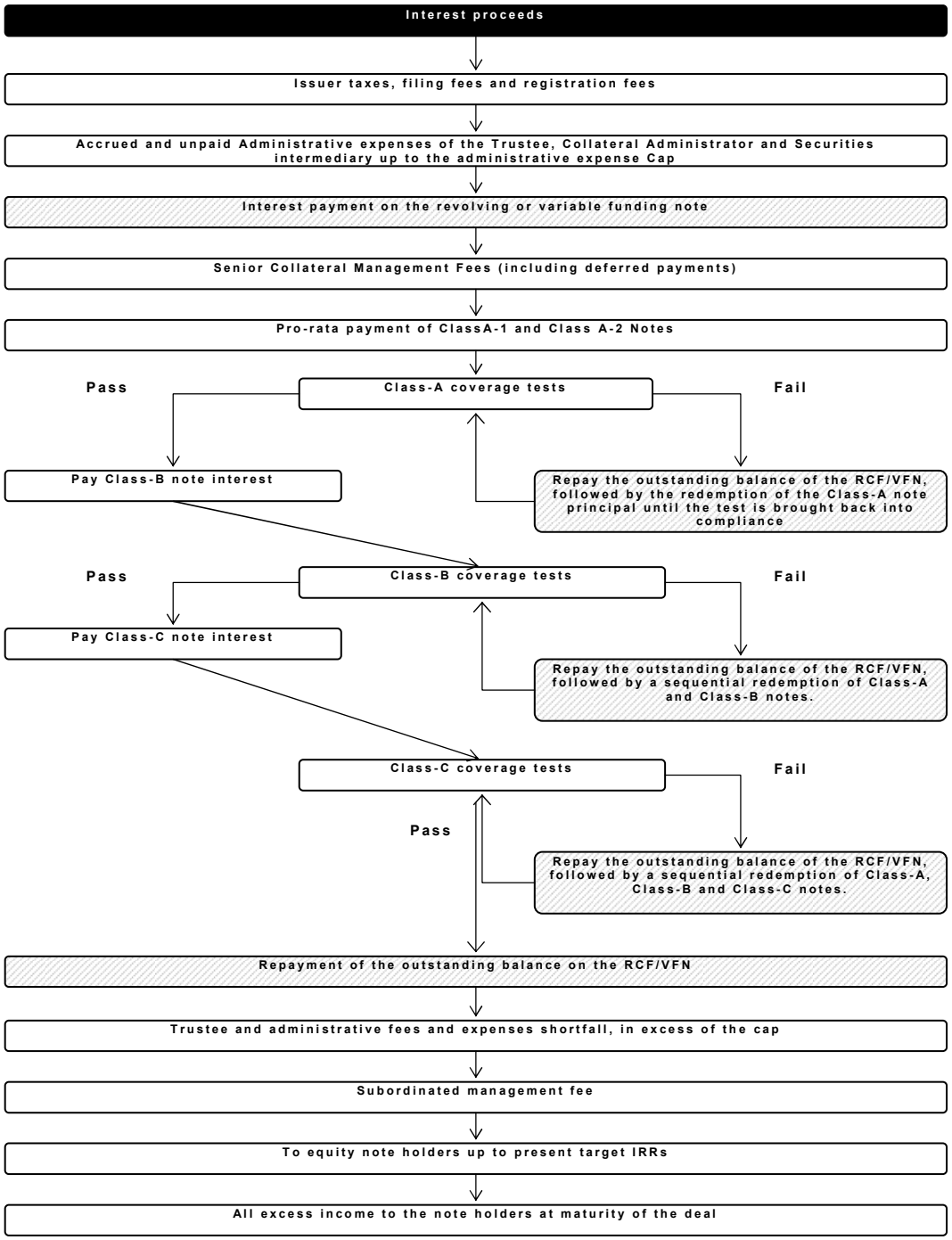
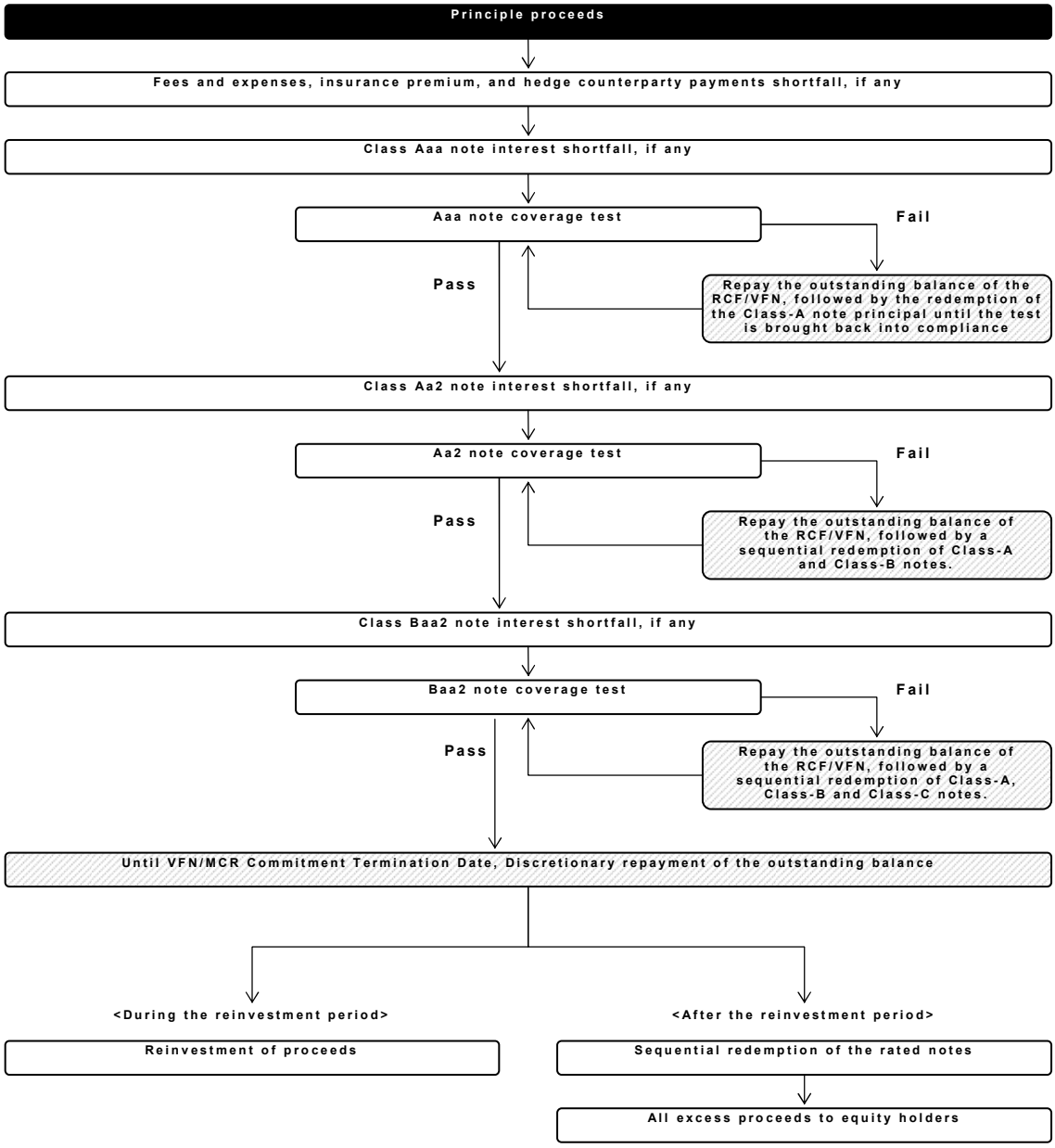


Figure 4-5: The principle proceeds waterfall of a multi-currency CLO, including a MCI



4.3.2. The consequences of incorporating multi-currency instruments (MCIs)

Multi-currency instruments, which are either MCR or VFN, can be and have been used to fulfil multiple purposes in multi-currency CLOs. The basic notion behind the use of a MCR/VFN was already explained in chapter 3. Therefore this section will limit itself to the various applications of the MCIs found in practise and explain how they influence the structure and the waterfalls of a CLO.

There are roughly three types of structures involving MCIs found in the market between the first quarter of 2006 and the 2nd quarter of 2007. The **first group** of CLOs consists of structures which use the MCI as an instrument to hedge the risk emanating from revolving loans purchased by the SPV. By issuing variable funding notes or multi currency revolvers, the SPV effectively passes the risk of an undrawn portfolio to any of the revolving instruments it purchased. If it receives a draw down request from the borrower under the revolving loan, the SPV in turn draws on the MCI to comply with the request. This structure is the least interesting as the MCI is in principle not used as a multi-currency hedging instrument, but rather to reduce the negative carry caused by the undrawn amounts. Therefore this category will be disregarded for the remainder of this project.

The **second category** contains CLOs which use the MCI as a reserve account. The MCI remains undrawn at closing and is solely used to cure any mismatches arising from a default in the collateral portfolio. This principle was elaborately discussed in chapter 3.

The **third group** includes transactions in which MCIs are used as a substitute for the duo currency structure. The MCI replaces the foreign denominated notes in the structure and the facility is drawn in the foreign currency in an amount equal to the collateral purchased by the SPV in that respective currency. By incorporating a MCR/VFN in the structure instead of issuing notes in different currencies, the SPV's reinvestments potential is significantly increased. The MCI allows the collateral manager to reinvest (p)repaid principle proceeds in any of the currencies nominated in the MCI agreement, without the necessity to enter into an expensive PAS to hedge the potential currency mismatch.

The waterfall

The inclusion of a MCI in the CLO structure can and mostly will have a significant impact on the interest and principle waterfall. The MCI is usually included in the waterfall on a senior or super senior level to lower the costs associated with this instrument. If the MCI is ranked super senior to the rated notes, it will receive priority in the distribution of all interest and principle proceeds. This is usually the case in the second category of CLOs.
In many transactions using this principle, interest proceeds remaining in the waterfall after the interest payments on all rated notes are used to repay the balance on the MCI. Similarly, (p)repaid principle proceeds have to be used to reduce the balance on the MCI to zero before any reinvestments can be made.

In the third category of CLOs the multi-currency instrument usually ranks pari-passu with the senior rated notes and receives interest and principle proceeds on a like-for-like or pro-rata basis. Shortfalls are eventually cured if any of the coverage tests are breached.

Repayment of the MCI balance

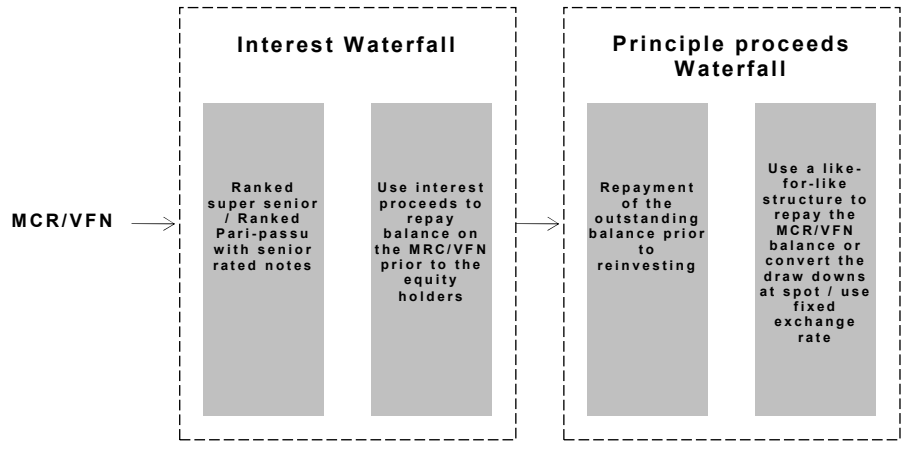
In most transactions the repayment of the outstanding balance on the MCI, whether at maturity or during the lifetime of the transaction, can be done in any of the nominated currencies under the MCI agreement up to the amount drawn in the respective currency. Any additional repayments will be converted using the spot-exchange rates to repay the outstanding balance in any of the other currencies. On rare occasions does a transactions fix the exchange rates at closing and use that exchange rate for the life time of the transaction.

Other transactions, however, maintain a strict like-for-like balance; amounts drawn on the revolver need to be repaid in the currency it was drawn in. As a consequence the currency risk is not fully mitigated; the issuer is still committed to, under the assumption that a draw down was made in Sterling, a Sterling principle repayment and a LIBOR + spread interest payment. This is notably different from the previous structure which allowed for a redenomination of the LIBOR + spread to EURIBOR + spread. Excess proceeds would have to be converted at the prevailing spot rate to GBP to (partially) repay the outstanding balance. This option would provide a natural hedge for the foreign denominated assets and could therefore be preferred by CLOs from group 3.

Summary

The preceding paragraphs are summarised in the schematic figure below, figure 4-6.

Figure 4-6: Summary of the consequences of incorporating MCIs



4.4. Test structures

Out of the three groups of CLO structures identified in section 4.2.2 the third category of structures, those structures which use the VFN as a substitute for the duo currency structure, appear the most suitable for the intended use by NIBC. Not only do these structures provide the collateral manager with an increased level of flexibility, they potentially reduce the hedging costs incurred by the structure by removing the PAS.
The removal of the PAS is, however, not without risk. Without the PAS the CLO is no longer hedged against defaults occurring in the foreign currency. Foreign asset defaults could therefore result in a asset liability mismatch, where the structure obtains Euro interest or principle on the assets and has to pay Sterling interest or principle on its liabilities. The impact of this potential mismatch on the performance of the structure will largely depend on the manner in which the VFN is included in the transaction's priority of payments.
A subsequent analysis of the CLOs in group 3 showed that the manner in which the VFN is included in the priority of payments of the CLOs can be broadly distinguished based on a limited number of structural features, including the:

- Ranking of the VFN - The relative position of the multi-currency instrument with respect to the senior notes: senior/ pari-passu;
- Ability to Redenominate - The ability to redenominate liabilities under the VFN/MCR during the reinvestment period. Redenomination is allowed as long as it does not cause an increase of the total euro equivalent of the liabilities under the VFN in excess of its maximum permitted size: senior redenomination/ no redenomination;
- Application of the multiple currencies – The manner in which the interest and principle proceeds are distributed among the pari-passu ranking notes: like-for-like/pro-rata;

Many CLOs also make a distinction with regards to the repayment of the outstanding balance of the VFN; repayment at the discretion of the CM, senior to reinvestments or junior to reinvestments. In consultation with NIBC it was decided not to test the latter structural feature in this exploratory research in order to limit the number of back and forth FX conversions.

Consequently, thus excluding the repayment options, there are 8 different combinations of structural features to be tested. These are:

ranking of the VFN: 2
ability to redenominated: 2
application of the multiple currencies: 2

in total: 2*2*2 = 8.
In order to assess the effect of the inclusion of any one of these combinations on the performance of a multi-currency CLO, they will be implemented in an existing CLO structure, the North Westerly III CLO. The variable funding note will replace the 35% bucket reserved for foreign denominated assets; resulting in a €140 million VFN, while

reducing the size of the senior notes with an equal amount. This will result in 8 different CLO structures, the test structures, which will look as follows, Table 4-4. A more detailed description of the consequences of the incorporation of structural features on the priority of payments is provided in appendix A5.

Table 4-4: Test-structures

	PAS Assumed cost	VFN Size	Portfolio spread (in bp)	Ranking VFN Senior/ Pari-passu	Structure type Like-for-like/ Pro-rata	Redenomination Yes/No	Abbreviated as
Base case structure	60 bp	n/a		n/a	Pro-rata	n/a	
structure 1	n/a	x	284	Senior	Like-for-like	Yes	SLY
structure 2	n/a	x	284	Senior	Like-for-like	None	SLN
structure 3	n/a	x	284	Senior	Pro-rata	Yes	SPY
structure 4	n/a	x	284	Senior	Pro-rata	None	SPN
structure 5	n/a	x	284	Pari-passu	Like-for-like	Yes	PLY
structure 6	n/a	x	284	Pari-passu	Like-for-like	None	PLN
structure 7	n/a	x	284	Pari-passu	Pro-rata	Yes	PPY
structure 8	n/a	x	284	Pari-passu	Pro-rata	None	PPN

The test-structures will be modelled in such a way that they can be stress tested using the methodology of Standard & Poor, one of the agencies which rated North Westerly III CLO, our base case structure. The test structures will use the original collateral pool used for the North Westerly III CLO, with the same trigger levels and recovery rates. The structures will only use a different priority of payments and receive a slightly higher average spread on the assets. The later is a consequence of eliminating the PAS, which reduces the average cost on foreign assets by 60 basis points. Consequently the average spread is increased with a percentage equal to the percentage of foreign assets multiplied with these 60 basis points. In addition, the test structures will be augmented with a number of EUR to Sterling American Options as a hedge against the fluctuations in FX rates. The minimum strike price used in these options is the spot price at closing. A lower strike price of the options would increase the upfront costs in the structure and consequently the size of equity. This in turn would diminish the performance of the equity.

In order to objectively asses the performance of the different test-structures, the next section will develop the test criteria which will be used in this research.

4.5. Criterion for comparison

History learns that CLO issuers have had the most difficulty with selling the equity tranche of the CLO structure. Long since its inceptions in 1987 issuers of CDO have retained this hard to value junior note. The inherent risk in the first loss position and uncertain returns meant that investor's interest was remote at best.
During the recent decade, the investor's appetite for the equity positions has improved. Money funnelled into specialised funds created a ready market for these junior, unrated positions which could on occasion offer a handsome return. The size of the market for the CLO's equity pieces remained small compared to the market for the more senior rated notes. Nonetheless, the issuers of CLOs were offered a ready market for their product and obtained the opportunity to offload the last piece of risk related to the collateral pool. Even so the limited size of the market ensured that the equity piece remained the hardest note to sell. Selling the equity tranche in the market required a good return on investment and a significant potential upside.

Nonetheless, structuring a CLO is a balancing act. The CLO issuer always faces the conflicting interests of the junior and the senior note holders. The senior note holders will demand a safe and secure investment. They are prepared to agree on only a modest margin as long as their initial investment is sufficiently secured and their interest income is guaranteed. To provide the desired level of security, the issuer will have to include various credit enhancement techniques which will inevitably lower the return on equity.
This obviously conflicts with the interest of the equity investors. These investors purchase the risky first loss position in the CLO and demand a high return on equity as a compensation for the assumed risk. The equity investors obtain the funds remaining in the structure after all other expenses have been paid. The benefits of credit enhancements are for the rated notes and come in as expenses at equity level, reducing the return on this position.

Because of these conflicting interests it is impossible to objectively compare different structures based on for example the trigger levels or swap agreements. From the note holders perspective these higher trigger levels and swap agreements will provide additional security. At the same time they will be regarded as an unnecessary expenses by the equity investors. To circumvent this problem, this research will ensure that each tranche of the rated notes issued by any of the test-structures assumes a similar level of risk. Assuming that note holders are risk neutral, they should be indifferent between the notes offered by any the structures.
Given that the risk assumed by all of the rated notes are equal, the test-structures can simply and unambiguously be compared based on their return on equity (ROE), where the return on equity equals the amount of money paid to the investors divided by the amount of equity included in the structure.

4.6. Conclusion

In this chapter a thorough analysis of the CLO market between January 2006 and June 2007 was provided. This analysis showed that limited number of structural features formed the basis of many multi-currency CLOs issued during this period. These structure features relate to the position of the VFN in the priority of payments of the CLO, the ability to use the VFN to redenominate the liabilities and the way in which the different currencies were used to fulfil these liabilities; like-for-like or pro-rata.

Based on these three structural features 8 different test-structures were developed which should allow for testing of the impact of these structural features individually as well as in combination with others. These 8 structures will be created by altering an existing CLO, the North Westerly III. They will use the original CLOs collateral pool, recovery rates and trigger levels; as such the structure will only differ from each other based on the discussed structural features.

The impact of these structural features on the performance of a CLO will be assessed by comparing the ROE which each of the structures is able to achieve in the equity scenarios developed for the NWIII.

But before the ROE can be determined, the next chapter will first introduce the base case, the North Westerly III CLO, and the rating methodology which will be used to test the 8 test-structures.

5. Base case: The North Westerly CLO III B.V.

5.1. Introduction

The qualitative discussion in the previous chapter elaborated on the mechanics of a multi-currency CLO incorporating a MCI. By analysing a number of structures used in the market the various applications of a MCI were documented and their influence on the structure's waterfall was explained. Subsequently some of these structures were selected in order to analyse the consequences of the various structural settings and to test the benefits provided by these structures relative to a multi currency CLO incorporating a PAS.

To further investigate the effect of each of the hedging strategies, these will be implemented in an existing CLO structure, the North Westerly III CLO, which will serve as the base case structure.

In the first part this chapter, section 5.2 a detailed overview of the base case structure will be presented. The settings and assumptions used in this model will serve as guidance for the structuring of the different hedging strategies.
The second part of this chapter, section 5.3, will elaborately discuss the rating process for CLO as practised by Standard & Poor's during the period commencing in January 2006 to mid-2007. This methodology was used in testing the base case structure and will be used on the test-structures. To illustrate how this methodology works, most of the steps will be applied to the asset portfolio of the North Westerly III CLO to show how these theoretical concepts work in practise.

5.2. The base case

The model created for the North Westerly CLO III B.V. will be used as central point for comparison. North Westerly CLO III B.V. ("North Westerly III" or "NW III") is a newly formed company, the SPV, with limited liability, incorporated under the laws of The Netherlands. North Westerly is NIBC's third arbitrage cash flow Collateralised Loan Obligation ("CLO") and is managed by NIBC as Collateral Manager. The outstanding shares of North Westerly CLO III are owned by Stichting North Westerly CLO III, a foundation established under the laws of The Netherlands.

North Westerly CLO III has issued five classes of rated notes and one class of unrated notes (Table 5-1), the proceeds of which have been used to purchase a portfolio primarily comprised of senior secured debt obligations (at least 80% of the portfolio comprises of senior secured debt obligations), second secured debt obligations and unsecured debt obligations, issued by companies with a primary place of businesses located in Western Europe, the US or Canada. These assets can be denominated in Euros, but also consist of non-Euro obligations (obligations denominated in US dollars, Canadian dollars or any currency of certain Western European countries). The different limitations related to the

pool of assets are detailed below in the section addressing the portfolio profile and quality tests.

Table 5-1: Capital structure

Class	Size (EUR mln)	Percentage Of Total	Expected Rating *Moody's / S&P*	WAL (years)[10]	Legal Final Maturity	Coupon
A	290	70.8%	Aaa /AAA	8.3	16 years	6-month EURIBOR +24.75 bps
B	32	7.8%	Aa2/AA	10.5	16 years	6-month EURIBOR +42 bps
C	17	4.1%	A2 /A	11.0	16 years	6-month EURIBOR +65 bps
D	15.5	3.8%	Baa2 /BBB	11.4	16 years	6-month EURIBOR +150 bps
E	14.5	2.4%	Ba2 /BB	11.8	16 years	6-month EURIBOR +400 bps

Class	Size1 (EUR mln)	Percentage Of Total	Expected Rating Moody's / S&P	Duration (years)[11]	Legal Final Maturity	Coupon
Sub	**40.8**	**11.1%**	**N.R./N.R.**	**5.0**	**16 years**	**Residual**

Class of combination notes[12]	Size (EUR mln)	Percentage Of Total	Expected Rating *Moody's / S&P*	WAL (years)[10]	Legal Final Maturity	Coupon
P	**10**		**Baa3**	**8.3**	**16 years**	**2.00% per annum**
Q	**7**		**BBB**	**10.5**	**16 years**	**1.00% per annum**
R	**6**		**Baa1**	**11.0**	**16 years**	**0.25% per annum**

[10] Weighted Average Life is, amongst others, based on 0% defaults per annum, 25% prepayments, fully ramped-up portfolio in 8 months, fully invested portfolio during the 6 year reinvestment period, and no exercise of the optional early redemption.

[11] For the Subordinated notes, Duration figures have been provided instead of Weighted Average Life, based on the same assumptions as those used for Weighted Average Life calculations.

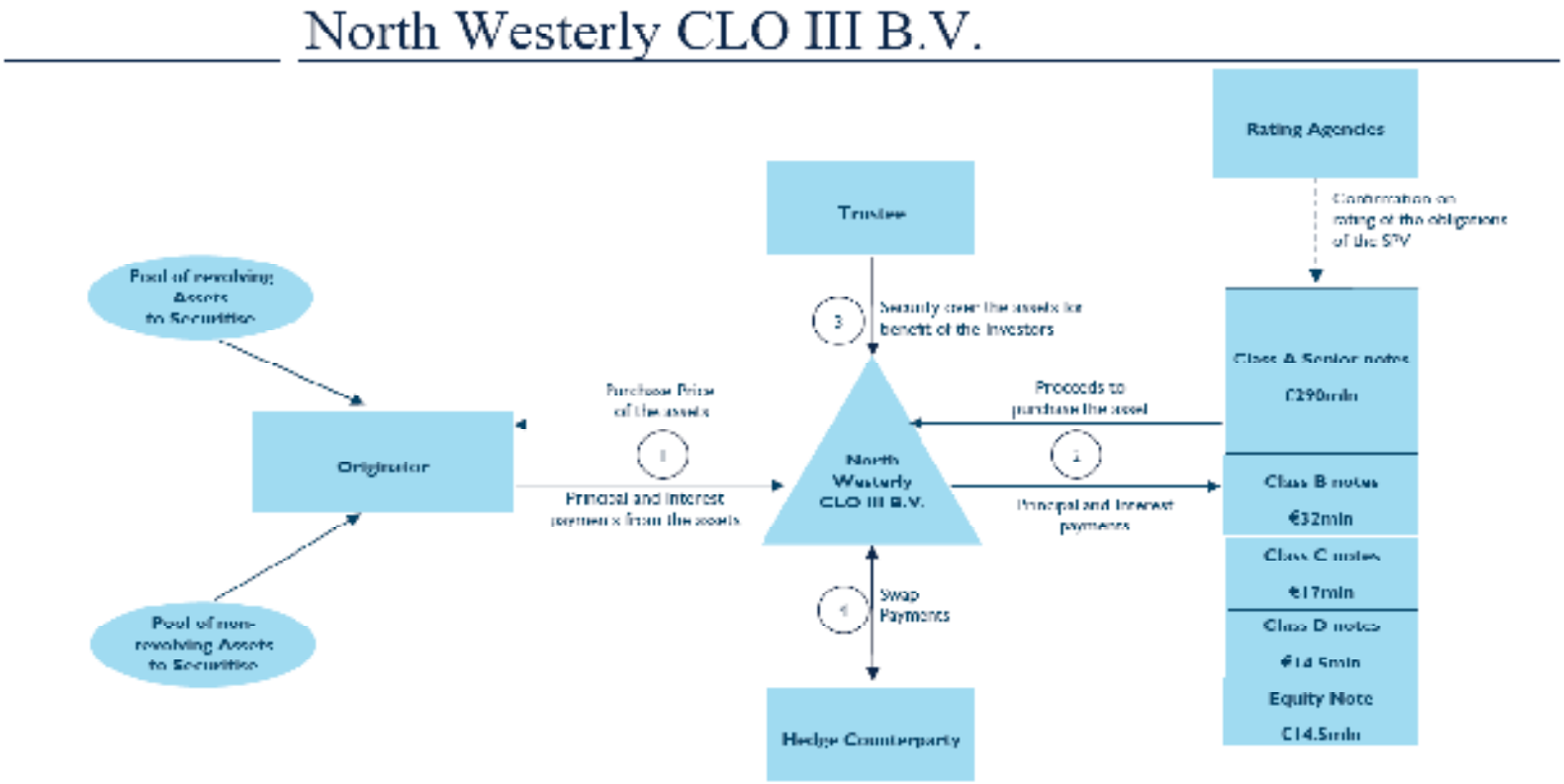
[12] Each Class P Combination Note consists of two "Components", one of Class D Deferrable Interest Notes and one of Subordinated Notes. Each Class Q Combination Note consists of two "Components", one of Class D Deferrable Interest Notes and one of Class E Deferrable Interest Notes. Each Class R Combination Note consists of three "Components", one of Class C Deferrable Interest Notes, one of Class D Deferrable Interest Notes and one of Subordinated Notes. The initial principal amounts of each of the Class P Combination Notes, the Class Q Combination Notes and the Class R Combination Notes are also included in the initial principal amounts of the respective underlying Classes of Notes.

The North Westerly CLO III entered into cross-currency asset swaps with one or more hedge counterparties in order to hedge the FX risk related to non-Euro denominated collateral debt obligations, but for a small bucket allowance (please see details below). It also entered into one or more interest rate swaps to hedge its exposure to fixed rate assets.

At closing North Westerly CLO III had acquired assets with an aggregate par amount of 60% of the total portfolio. During the 365-day ramp-up period the aggregate collateral balance was brought up to the Target Amount.

The overall structure is described in Figure 5-1

Figure 5-1: Transaction Structure



Step 1: The originating company sells a portfolio of receivables to the SPV
Step 2: SPV finances the purchase of the receivables by issuing a combination of notes with rating ranging from unrated up to AAA
Step 3: A trustee oversees the SPV and protects the interests of the noteholders
Step 4: To hedge the mismatch between the interest paid on the assets and the those paid on the notes the SPV may enter into hedge agreements

5.2.1. Structure summary

Issuer:	North Westerly CLO III B.V.
Collateral Manager:	NIBC Bank N.V.
Structure:	Cash flow CLO
Issuance:	Class A Senior Floating Rate Notes, Class B-E Mezzanine Floating Rate Notes ("Deferrable Interest Notes"), and Subordinated Notes
Closing Date:	June, 2006
Closing Portfolio:	60-65% of the assets were purchased (or committed for purchase) by the Closing Date
Ramp-up Period:	The CLO will have 365 days after the closing to acquire the remaining portion of the portfolio
Reinvestment Period:	6 years
Legal Final Maturity:	16 Years
Optional Redemption:	On or after 6 years at the direction of holders of the Subordinated Notes
Payment Dates:	Semi-annual
Management Fees:	15 bps senior management fee, 50 bps subordinated management fee, incentive management fee of 20% of excess cash flow after Subordinated Notes have realised an IRR of 12%
Interest Reserve Account:	EUR 2.5 million

5.2.2. Key Portfolio Characteristics

The Collateral Manager acquired, on behalf of North Westerly III, a diversified portfolio of debt obligations issued by companies with a principal place of business in a European country. The composition of the asset portfolio, and therefore the level of diversification achieved, is subjected to the portfolio tests (Table 5-2). The Target Par Amount of the portfolio is EUR 400 million, 409 million at closing. The excess par amount obtained by the issuance of the notes is used to fund the costs related to the structuring process.
The portfolio will comprise of senior secured and second secured debt obligations denominated in Euro or other eligible currencies. The issuer will enter into PAS for non-Euro denominated assets to hedge the currency risk.

Table 5-2: Portfolio eligible criteria

Selected Portfolio Profile Tests	Covenant Limit of Target Par Amount	Actual Portfolio at closing
Senior Secured Debt Obligations	80.0% Min	90.24%
Second Secured Debt Obligations	20.0% Max	9.76%
Unsecured Debt Obligations	7.5% Max	0.00%
Second Secured Debt Obligations and Unsecured Debt Obligations	20.0% Max	9.76%
Non-Euro Obligations[13]	35.0% Max	14.50%
Structured Finance Securities	Not allowed	0.00%
Single Obligor Concentration[14]	2.5% Max	-
Annual or longer Coupon Basket	10.0% Max	-
Non-Floating Rate Obligations	7.5% Max	-
Collateral rated Caa1/ CCC+ or less	5.0 % Max	0.00%
Total Participations	20.0% Max	-
Total Synthetic Securities	20.0% Max	-
Total of Participations and Synthetic Securities	20.0% Max	-
Revolving Loans	3.0% Max	-
Tradable Assets (per annum)	20.0% Max	-
Long Dated Basket	2.5% Max	-
Selected Collateral Quality Tests[15]	**Test**	**-**
Weighted Average Life	11 yrs Max	7.65 yrs
Average Moody's Rating Factor[16]	2300 Max	2300 Max
Diversity Score	30 Min	30
Moody's Weighted Average Recovery Rate	58% Min	58% Min
S&P's Weighted Average Recovery Rate	50% Min	50% Min
Weighted Average Cash Spread	275 bps Min	302.48 bps (309.73 bps Excluding PAS)

[13] Note: For the purpose of this study, the number of different currencies will be reduced to two; Euro en Sterling. Using a dual instead of multi-currency model will significantly reduce the complexity of the model, while it should preserve the risk related to currency fluctuations and therefore not significantly influence the observations made based on this model.

[14] Except for up to 5 exposures, which can each represent up to 3.0% of the portfolio Target Par Amount and for up to 2 exposures, which can represent up to 3.5% of the portfolio Target Par Amount

[15] Diversity Score, Weighted Average Cash Spread, WARF and Weighted Average Recovery Rate are subject to Rating Agency matrix grid

[16] In addition to the Rating Factor and Diversity combination given above, the CLO may be subject to alternative Rating Factor and Diversity constraints as further described in the final Offering Memorandum. The ratings assigned to the Collateral Debt Obligations by the Rating Agencies, will be based upon available public ratings, private shadow ratings, or a mapping from NIBC Bank N.V., as further described in the final Offering Memorandum.

To provide additional protection to the interest of the rated note holders the North Westerly model incorporates both an OC and IC test in addition to the profile and quality tests specified above, Table 5-2. The IC and OC test ensure that in the event of an interest or principle shortfall the senior notes receive interest and principle proceeds prior to the more junior rated note. The IC and OC ratios are calculated using the following formulas:

$$\text{IC Test of tranche X} = \frac{\text{Expense Reserve Account + Collateral Interest Proceeds + receipts from Hedge counterparties – Estimated Senior Expenses}}{\text{Interest on Tranches Senior to X + Interest on Tranche X}}$$

$$\text{OC Test} = \frac{\text{Total Collateral + Principle Account + Additional Collateral Account}}{\text{Remaining Principle Amount of the Tranches senior to Tranche X + Remaining Principle Amount Tranche X}}$$

For the purpose of calculating the OC-test numerator the principle balance of securities which are or have become defaulted obligations shall be the lower of the market value and the recovery value relating to such defaulted obligation provided that during the period of 30 days beginning on the date on which such collateral debt obligation is designated as a defaulted obligation by the collateral manager.

The covenanted threshold levels for the IC- and OC-tests used in the North Westerly model are as indicated in Table 5-3and Table 5-4 respectively.

Table 5-3: Interest coverage tests

Coverage Tests	Minimum
Class A Senior Interest Coverage Ratio	130.0%
Class B Interest Coverage Ratio	130.0%
Class C Interest Coverage Ratio	115.0%
Class D Interest Coverage Ratio	110.0%
Class E Interest Coverage Ratio (Direct Pay Test)	102.0%

Table 5-4: Overcollateralisation test

Coverage Tests	Expected on Effective Date[17]	Minimum
Class A Senior Par Value Ratio	137.9%	125.9%
Class B Par Value Ratio	124.2%	114.2%
Class C Par Value Ratio	118.0%	109.0%
Class D Par Value Ratio	112.8%	106.8%
Class E Par Value Ratio	109.7%	104.7%
Interest Reinvestment Test (Such Test, when breached, will cause a diversion of up to 50.0% of the interest proceeds otherwise payable to (a) Subordinated Fees and (b) the Subordinated Notes into the Principal Account for Reinvestment)		106.0%

5.2.3. The waterfalls

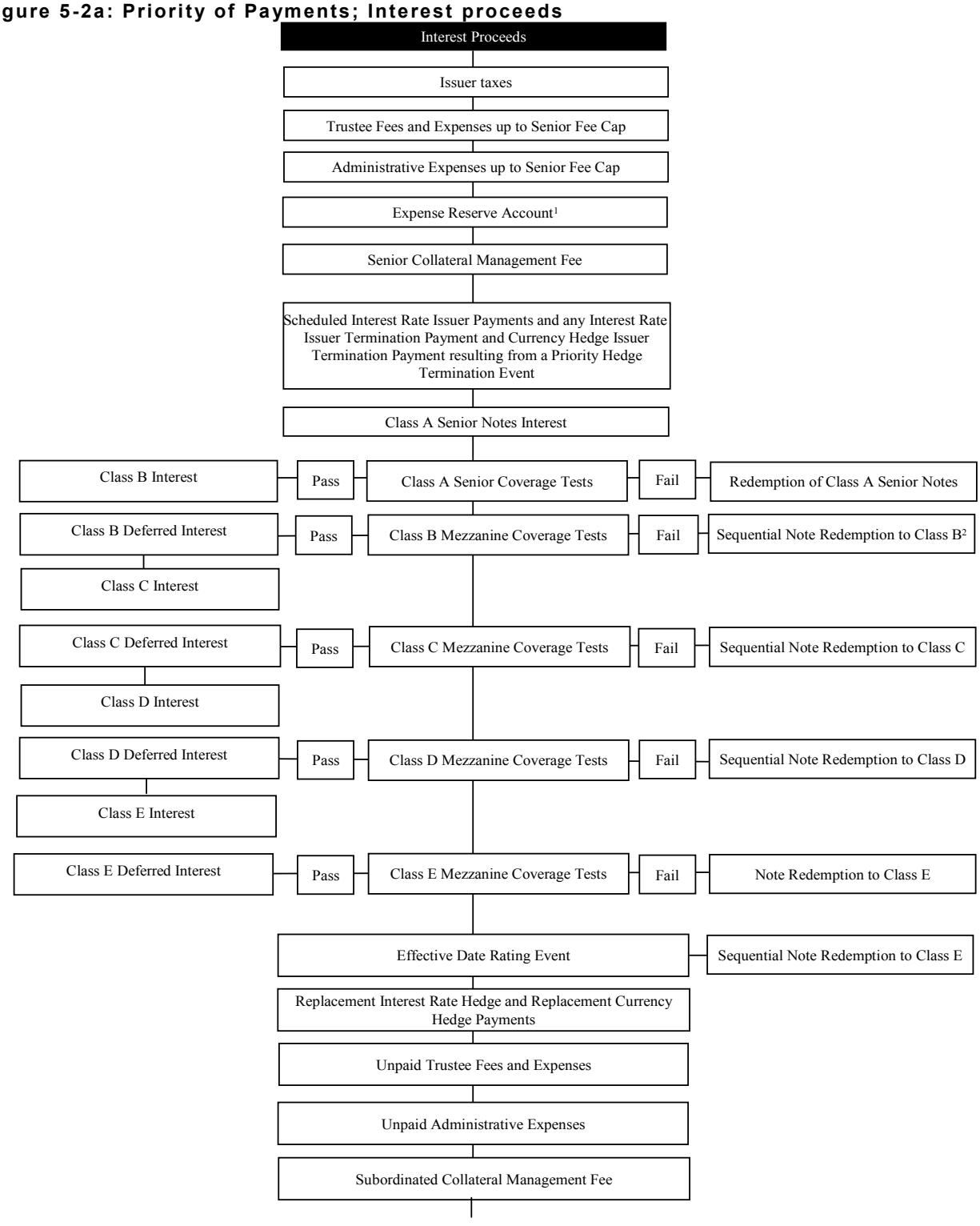
The interest and principle proceeds received on the collateral during the life time of the transaction will be used to pay interest on and finally redeem the liabilities of the CLO. Interest received on the collateral is distributed according to the CLO's interest priority of payments summarised in Figure 5-2. The initial interest receipts will be reduced by the CLO's senior expenses before being distributed among the rated note holders, according to their seniority and subjected to the condition that the IC- and OC-test are passed. A breach of the IC or OC test will initiate a sequential redemption of the senior notes until the tests are brought back in compliance. There is, however, one exception: the North Westerly model includes a special feature, a turbo feature, which triggers priority redemption of the class E notes on a breach of the class E interest coverage test. The interest available in the structure's waterfall after paying interest to all classes of notes senior to class E will first be applied to the redemption of the remaining class E notes in order to bring the test back into compliance. Any remaining interest proceeds will be used to fulfil any deferred liabilities, such as unpaid Trustee expenses and Administrative expenses, prior to being reinvested or paid out to equity investors.
Here it should be noted that reinvestments with interest will only occur during the reinvestment period and on a breach of the reinvestment test. This OC-like test measures whether the transaction assets are deemed sufficient to meet it future liabilities. The test is calculated in a similar manner to a regular OC-test at class E level, after paying part of the junior expenses. In case of breach of the reinvestment test the collateral manager has to either reinvest 50% of the available interest proceeds into new assets or use these proceeds to redeem the notes sequentially. The threshold level for the reinvestment test is included in Table 5-4.

(P)repayments of principle on the North Westerly CLO's collateral or principle derived from an asset sale is distributed to the investors according to the priority of payments

[17] *Actual characteristics on the Effective Date may differ due to market conditions and liquidity constraints at the time of collateral purchase*

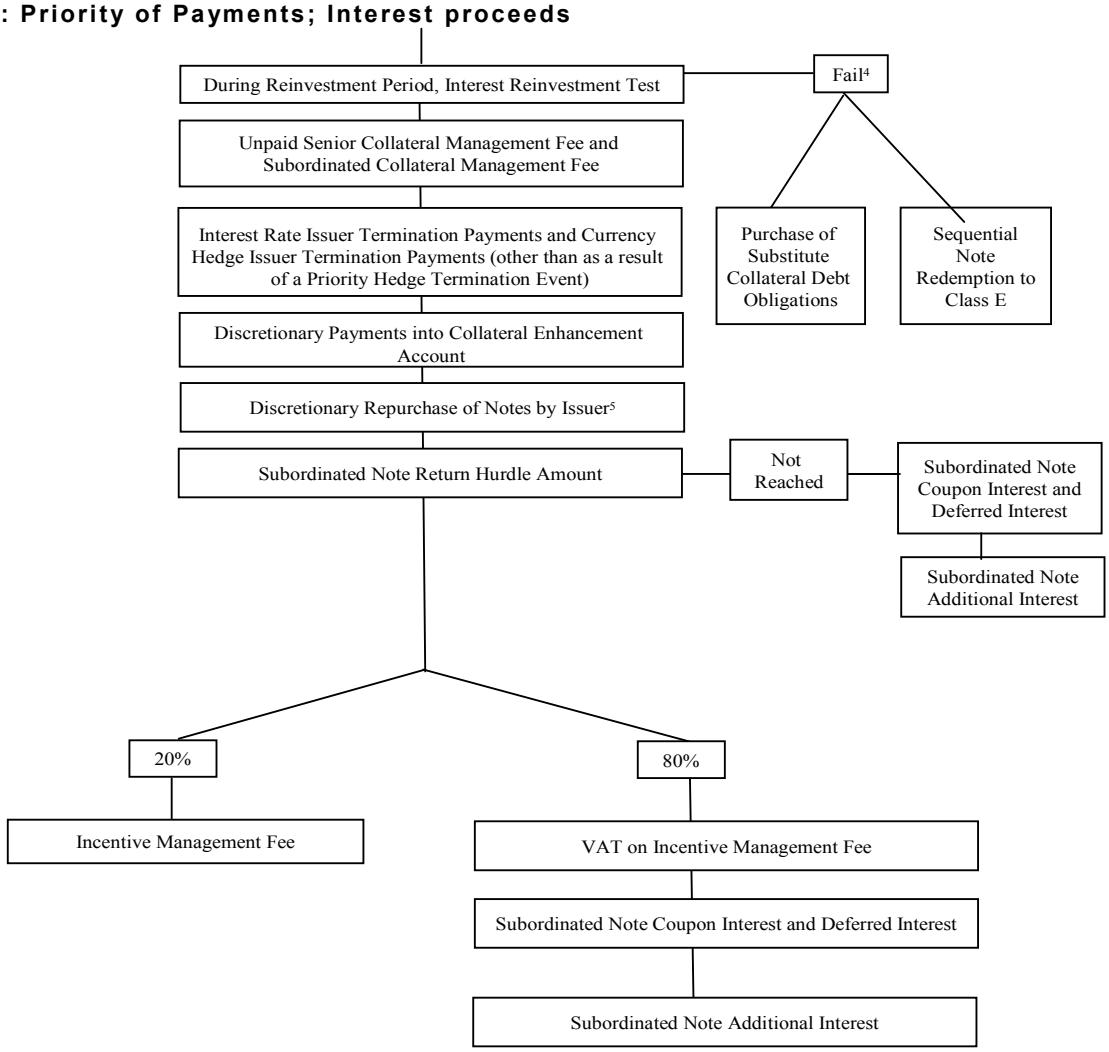
indicated in Figure 5-3. Analogous to a breach of the IC test, a breach of the OC-test will result in a sequential redemption starting with the most senior notes, as indicated in Figure 5-3.
During the reinvestment period, and in absence of a breach of the OC-test, principle proceeds will be reinvested in eligible collateral and/or used to sequentially redeem the rated notes at the discretion of the collateral manager. Post reinvestment period, unscheduled principle proceeds and sale proceeds will be applied in a similar manner. All other principle proceeds will be used to sequentially redeem the rated notes.

Figure 5-2a: Priority of Payments; Interest proceeds



1. Please refer to Condition 3(c)(i)(D) for more detail on such payment into the Expense Reserve Account.
2. After the Effective Date only. Please refer to Condition 3(c)(i) for more detail on the sequential redemption of Notes in these circumstances.

Figure 5-2b: Priority of Payments; Interest proceeds



[4]. Please refer to Condition 3(c)(i)(Z) for more detail on the application of Principal Proceeds in these circumstances.
[5]. Please refer to Condition 7(j) for more detail on the repurchase of Notes by the Issuer.

Figure 5-3a: Priority of Payments; Principle proceeds

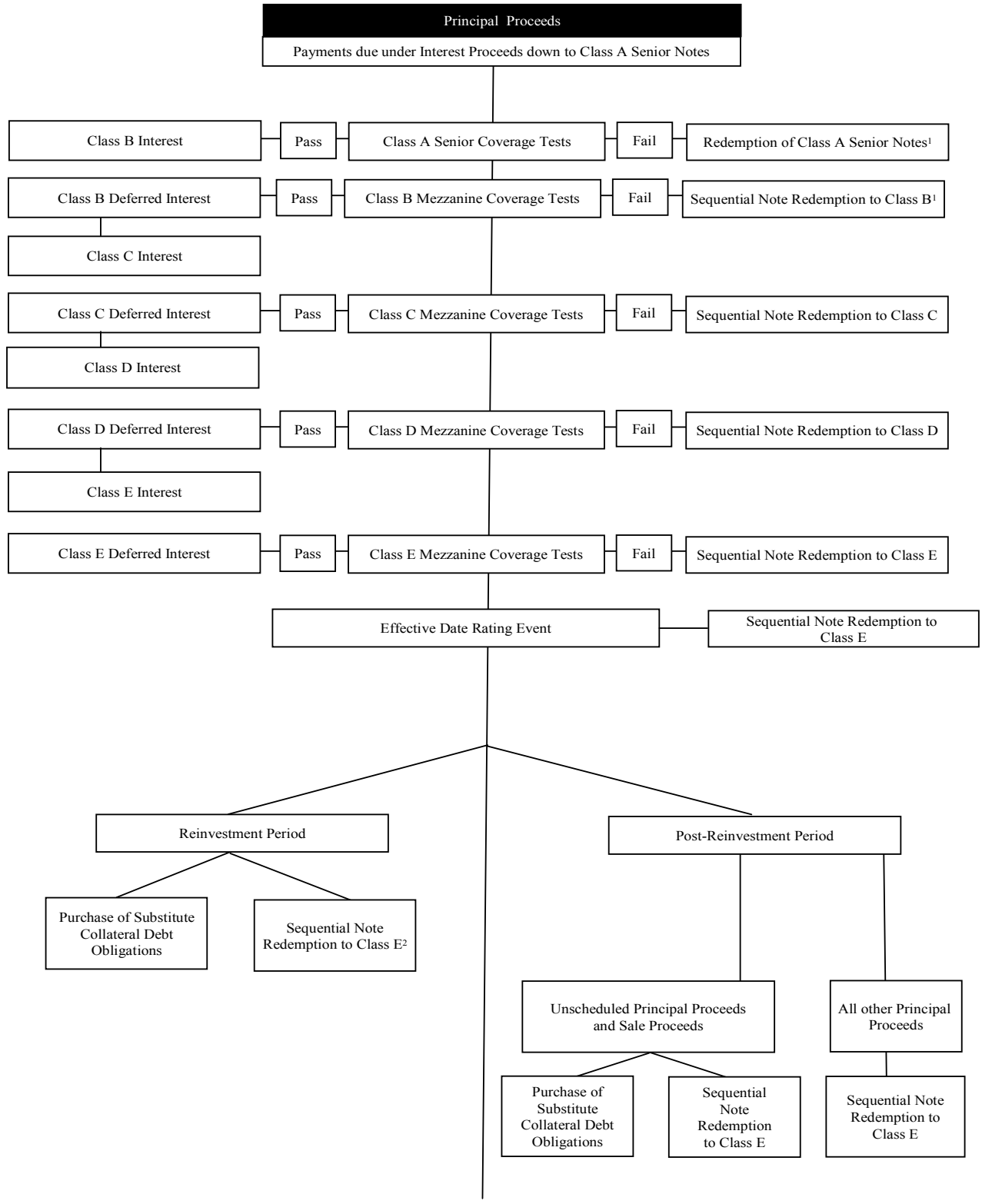
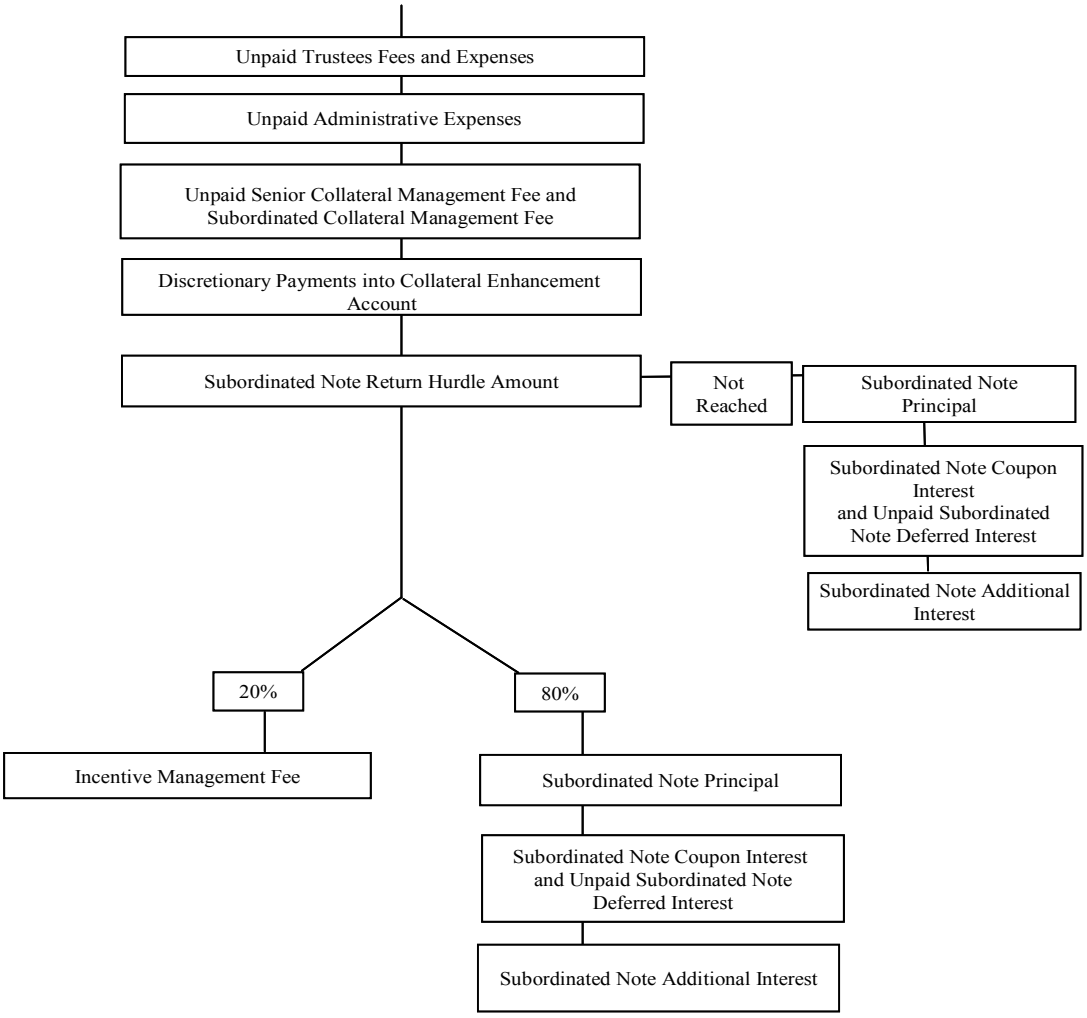


Figure 5-3b: Priority of Payments; Principle proceeds



[1] Please refer to Condition 3(c)(ii) for more detail on the sequential redemption of Notes in these circumstances.
[2] Please refer to Condition 3(c)(ii)(P) for more detail on the application of Principal Proceeds in these circumstances.

5.2.4. Hedging in the NWIII

The original foreign exchange hedging strategy included a number of Individual asset swaps to hedge each of the non-Euro Obligation; however not all of the FX risk was covered by perfect asset swaps.

North Westerly CLO III entered into an asset-based currency hedge each time it purchases a Collateral Debt Obligation denominated in a currency other than Euro (each a "Non-Euro Obligation"). The currency hedges are structured with optionality to account for defaults and prepayments during the life of the underlying asset. This optionality essentially removes the exposure to termination payments under the currency hedge in case of default or prepayment of the underlying asset. Non-Euro Obligations which become defaulted obligations must be sold within 12 months in order to be converted at the initial exchange rate. North Westerly CLO III may enter into currency hedges with one or more hedge counterparty. The currency risk which could affect North Westerly CLO III in case of default of a hedge counterparty is mitigated by the fact that:

- In the event of an Initial Rating Event, as stipulated in the offer circular as a downgrade of the hedge counterparty's short term unsecured debt rating by Moody's below "A1", the counterparty must either (within 30 days of such downgrade) find a replacement hedge counterparty or a guarantor of its obligations, or post an amount of collateral; and
- In the event of a Subsequent Rating Event, a downgrade below "Baa1",(or withdrawal of such hedge counterparty's rating), the counterparty must (within 10 days of such downgrade) increase immediately the posted collateral to an amount equal to the Required Collateral Amount as specified in the OC.

Failure by the swap counterparty to post additional collateral upon loss of the second rating trigger is an Event of Default with respect to such swap counterparty.

The Portfolio Manager will have the possibility not to perfectly hedge a part of the Non-Euro Obligations for the six month period following the purchase of the asset, provided such non hedged Non-Euro Obligations do not represent more than 5% of the total portfolio and are purchased in the primary market (i.e. purchase within three months of issuance). This ability will be conditional to all portfolio profile tests, collateral quality tests and coverage tests being satisfied after giving effect to such purchase. For the purpose of calculating the coverage test the principal amount of such imperfectly hedged Non-Euro Obligations are applied a 15% haircut to account for any FX volatility risk (this FX volatility risk is the 6-months volatility risk of Non-Euro authorised currencies against Euro, on which a stress on standard deviation is applied). For the purpose of calculating the weighted average spread test and the IC test, the same 15% haircut is applied on interest payments from these assets. Finally, if a perfect asset swap is not entered into on such imperfectly hedged Non-Euro Obligations after 6 months, or if the bucket exceeds 5%, then such imperfectly hedged Non-Euro Obligations are carried at a zero value for all purpose.

Interest Rate

Some Interest rate risk could be present in the original structure as up to 5% of the collateral may consist of fixed rate Collateral Debt Obligations, while all the issued notes

are paying interest on a floating rate. However, S&P is comfortable with this level of risk and consequently it will not be modelled.

The hedges described above and the other structural features included in the NWIII were tested and rated by S&P. The same methodology used in testing and rating the NWIII will be applied to the test-structures, in order to facilitate a comparison between the ROE these different structures are able to achieve. To determine how the S&P rating process works, this rating methodology will be described in the next section.

5.3. The Standard and Poor's rating methodology

Collateralised loan obligations are dynamic, multivariate structures which, according to S&P, require a flexible yet disciplined rating approach. The rating assigned based on this approach addresses the likelihood of full payment of interest either on a timely or ultimate basis, and of ultimate return of principal to note holders. Specifically, it addresses the likelihood of the first-Euro-of-loss based on the stated interest and principle terms.
The rating assigned to each tranche of the CLO reflects the assessment of risk given the transaction's structure, credit enhancement, and legal structure. If the losses on the pool of assets are shared pro rata, with the first dollar of loss shared among all investors, then the risk taken by any one investor would be no better than the weakest credit in the pool. If, however, losses are distributed in a prearranged order, like in a tranched structure, then each level of investors faces a different level of risk. The junior note holders would absorb the losses first, up to a certain dollar amount, before the higher-level investors are hit with losses.

The rating process is usually initiated by the sponsor, who requests the rating agencies to assign a credit rating to the notes issued by the CLO. To comply with the request the rating agency will require the sponsor to disclose detailed information about the transaction, prior to launching its rating process. Usually this information is exchanged by means of multiple discussions about the transactions structural features, a detailed transaction book and the submission of a term sheet. Once the rating agency has been sufficiently informed about the transaction, the rating process will begin.

The rating process of S&P consists of a number of specific steps, which have to be taken in order to arrive at a credit rating of the CLO's notes. These steps are as follows:

- Reviewing the structural basics and legal structure,
- Sizing the default frequency of the proposed asset pool*,
- Reviewing the collateral manager,
- Sizing the expected loss given default*,
- Reviewing of the transaction's collateral and structural features*,
- Testing whether the proposed level of credit support for each tranche is sufficient by modelling the transactions cash flows*,
- Convening a ratings committee to assess preliminary ratings,
- Reviewing final documentation and legal opinions, if required, and finally
- Issuing the rating(s) of the transaction.

Not surprisingly, most parties involved in the structuring process are most concerned with the above steps indicated with an asterisk. These steps provide an indication of the required level of credit enhancement needed to achieve the desired credit rating.

5.3.1. Sizing the default frequency

The assessment of the required amount of credit enhancement typically begins with an evaluation of the default frequency of the proposed asset portfolio used as collateral in

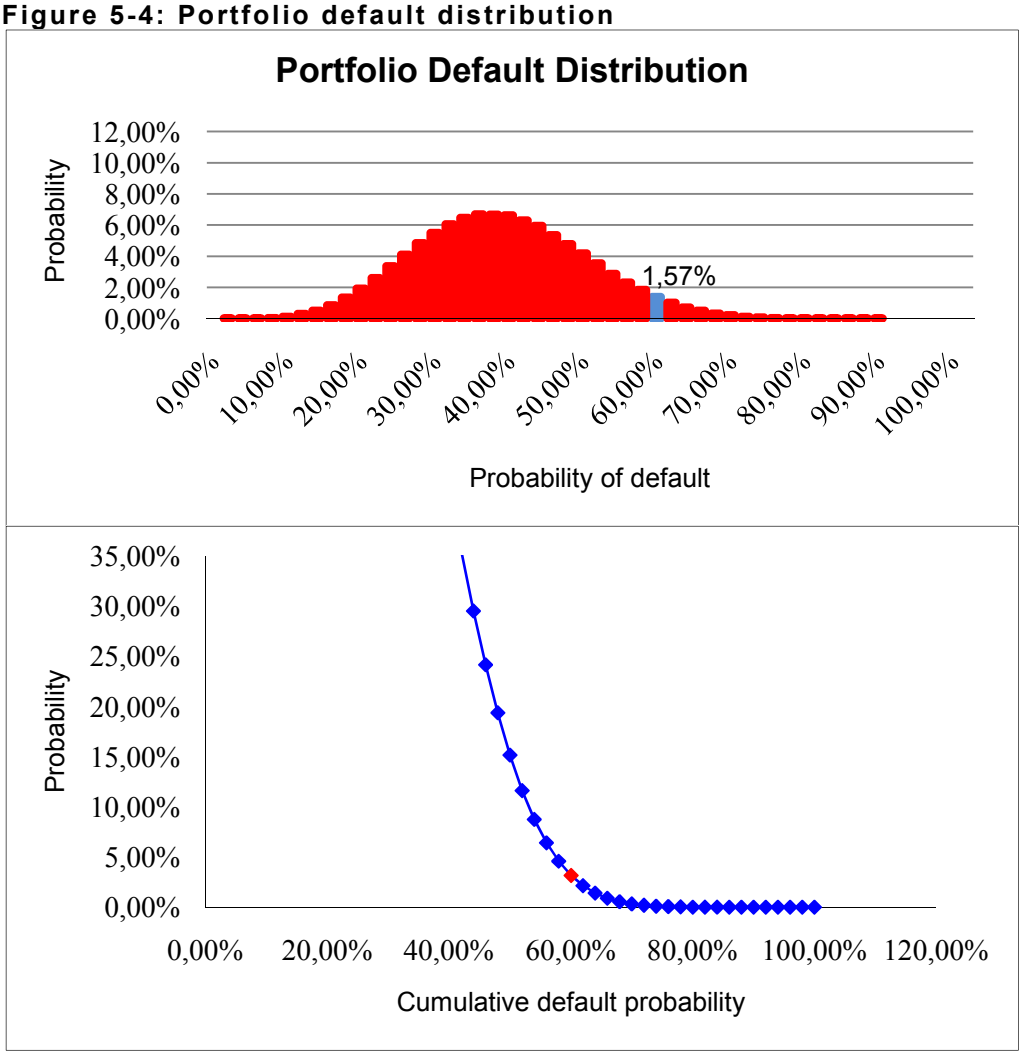
the structure. The principal model used by S&P to make this evaluation is the CDO Evaluator, which employs a Monte Carlo simulation, see appendix A6, to calculate the expected default level of the proposed pool in each rating scenario. The model uses default probabilities for each asset in the pool, based on their existing corporate ratings assigned by S&P (or other public rating agencies) to estimate a probability distribution of potential default rates for the aggregate portfolio. In other words, it uses a statistical methodology to evaluate the credit quality of the portfolio of the CLO's assets in order to provide the scenario default rates (SDRs) for the portfolio at each rating level.
The potential default rates range from 0% (no assets in the portfolio default by maturity) to 100% (all assets in the portfolio default by maturity). The portfolio default rate is calculated as the total Euro amount of assets defaulted by maturity, divided by the total principal amount of the portfolio. To these default rates probabilities are assigned and based on these probabilities the expected default rate in each rating scenario is determined.

Box 1: North Westerly III CLO example
Table 5.5 provides an overview of the collateral used in the NWIII. The asset portfolio consists of 226 single B rated loans with an average maturity of 11.785 years.
To get an impression of the expected default rate of the NWIII collateral portfolio, the portfolio was analysed using the S&P CDO evaluator. Using the standard S&P correlation assumptions for asset defaults, the CDO evaluator created a histogram of the default rate probability distribution for the collateral underlying the North Westerly III CLO, table 5-5. This probability distribution shows that for example the likelihood of a 60% default rate in the NWIII collateral portfolio would approximately be 1.57%.

Table 5-5: NWIII portfolio overview

	Statistics for the Entire Portfolio
Number of entries	226
Number of obligors	76
Total principal balance	$1,819,999,996.00
Current Assumed Recovery	$0.00
Weighted Average Maturity (years)	11.785
Weighted Average Rating	B

Figure 5-4: Portfolio default distribution



After estimating the probability distribution of the default rate of a given portfolio, it is possible to derive a set of Scenario Default Rates (SDRs). Each SDR is the default rate that a CDO tranche should be able to withstand under the various cash flow scenarios encompassed by Standard & Poor's rating criteria in order to be assigned a specific credit rating.

The value of the SDRs is calculated using a two-step process. But before discussing these two steps, note that each credit rating is essentially just a reflection of the estimated probability of default. Therefore the first step in calculating the SDR is to determine the maximum default rate of the portfolio above which the cumulative probability of a higher default rate occurring is equal to the probability of default at a desired rating. The default probability for an A-rated corporate liability during the next year is for example 0.022%. Similarly, for the same asset the probability of default during the next 12 years is estimated at 2.534%. The values associated with these default rates can be found in appendix A.9. Hence, in order to achieve a given credit rating, the portfolio default rate is supposed to be no greater than the probability of default of a

corporate bond with that rating. Second, multiply this portfolio default rate by an adjustment factor designed for the specific tranche rating. This adjustment factor, which may be either greater than or less than 1.0, depending upon the specific tranche rating, partly reflects the fact that the assumed probabilities of default for each asset are only estimates of the likelihood of default and not the eventual default experience of that particular asset class prior to the maturity of the portfolio.

Box 2: North Westerly III CLO example

Following this two step approach, the SDR for a single A-rated tranche for the North Westerly CLO III would be estimated at 60.49%. The probability of default within the average maturity of the asset portfolio, 11.875 years, for a corporate bond with an A-rating is estimated at 2.450%. This result is obtained by interpolating between the default probabilities estimates given for corporate bonds with a maturity of 11 and 12 years. The adjustment factor used by S&P in calculating the analysis of the NWIII collateral pool was 1.517.

If the respective tranche in the North westerly model is able to survive a percentage of defaults less or equal to the calculated SDR, then the probability of default of this tranche would be lower than 3.717% (=2.450*1.517), and the tranche would be appropriately rated single A.

5.3.2. Sizing the loss given default

When the structurer has determined the SDRs for each credit rating, he knows the level of defaults each tranche of his structure has to be able to withstand to qualify for his desired rating. Usually the SDR levels are significantly higher than the expected portfolio default levels. Therefore the structure has to include various credit enhancements to increase its robustness and thereby ensure that each rated note will survive the corresponding SDRs.

In absence of excess spread or recoveries on defaulted assets, the level of credit enhancement which would have to be included in the structure would match the default rate. However, most transactions do give credit to recoveries where feasible and include excess spread as to lower the level of credit enhancement required for a desired rating.

By giving credit to recoveries these transactions decreases the severity of a loss by an amount equal to the recovery rate multiplied by the defaulted principle balance.

Prior to January 2007 S&P assumed that recoveries were driven by three main factors:

- Seniority and security of the obligation - here it is assumed that the recovery on more senior or secured obligations is higher than on unsecured or subordinated claims;
- Time allowed to achieve the recovery - loan recoveries are assumed to occur within one payment period after the default. However, interest on such recoveries will not accrue and any missed interest payments will not be received; and
- Post-default management through the recovery process.

The original credit rating of the obligor was deemed to be less important; after default the expected recovery was assumed to be mainly driven by the relative seniority and how secure the obligation was.

With the release of the "CDO spotlight: Using Standard & Poor's recovery ratings in cash flow CDOs" in October 2006, S&P started to differentiate between the recovery rates in different ratings scenarios. The main reason cited for this modification was that in a high stress scenario, like the AAA scenario, recoveries on defaulted assets are expected to be lower due to the higher number of defaults and severe economic stress, relative to the recoveries in a say BB scenario.
In addition, S&P elaborated on the differences which exist between the recoveries among nations based on their respective bankruptcy laws. As such defaults occurring in countries with more favourable bankruptcy laws are assumed to have higher recoveries than defaults occurring in less regulated or less favourable regulated countries.

Simultaneous with these modification S&P adopted different recovery estimation methodologies as a substitute of the single methodology introduced above:

- The "Tiered" asset class approach in cash flow modelling: which uses different recovery rates for each loan/bond class at each CDO tranche rating (table 5.6); and
- The Asset-specific approach: which uses the S&P recovery rating for each loan/bond of a specific issuer at each CDO tranche rating (table 5.7). This is applicable only for assets which have been assigned a Recovery Rating.

Box 3: North Westerly III CLO example
When the tiered approach is applied to the collateral used in the NWIII structure, the estimated weighted average recovery rate would be 68% in a triple A scenario, increasing to 85% in a single B scenario, table 5.6.

In contrast, when the asset specific approach is applied to the collateral pool used in the NWIII transaction, the recovery rate is expected to fall somewhere within the range of 50 % to 65% in a triple A scenario, table 5.7.[18]

Table 5-6: Recovery Rates tiered approach

	Recovery ratings (%)					
CDO liability rating	AAA	AA	A	BBB	BB	B and CCC
Senior secured loans (%)	68	73	78	81	85	85
Mezz./second-lien/senior unsecured loans (%)	45	47	50	52	54	54
Subordinated loans (%)	20	20	20	20	20	20

[18] Granted that NIBC does not uses asset specific ratings and is therefore unable to apply this methodology

Table 5-7: Recovery rates assets specific approach

CDO liability rating								
Mezz. loans/second-lien/senior unsecured loans			Recovery ratings of senior secured (%)					
	Analytical description	Indicative recovery expectation (% of principal)	AAA	AA	A	BBB	BB	B and CCC
1+	Highest expectation for full recovery of principal	100	65	68	71	73	76	76
1	High expectation for full recovery of principal	100	57	60	63	65	68	68
2	Substantial recovery of principal	80-100	50	53	55	57	59	59
3	Meaningful recovery of principal	50-80	42	45	47	49	51	51
4	Marginal recovery of principal	25-50	18	18	18	18	18	18
5	Negligible recovery of principal	0-25	8	8	8	8	8	8

Subordinated loans			**Recovery ratings of senior secured (%)**					
	Analytical description	Indicative recovery expectation (% of principal)	AAA	AA	A	BBB	BB	B and CCC
1+	Highest expectation for full recovery of principal	100	22	22	22	22	22	22
1	High expectation for full recovery of principal	100	20	20	20	20	20	20
2	Substantial recovery of principal	80-100	18	18	18	18	18	18
3	Meaningful recovery of principal	50-80	18	18	18	18	18	18
4	Marginal recovery of principal	25-50	9	9	9	9	9	9
5	Negligible recovery of principal	0-25	4	4	4	4	4	4

The potential difference in the recovery rate obtained by using the different approaches might pose a point of concern. Recovery rates significantly influence the performance of a structure; as such structures will arbitrage between the two methodologies attempting to obtain the highest recovery rate possible.

When the original NWIII structure was created, the new S&P methodology was yet to be launched. Using the previous methodology the asset portfolio was estimated to have a 52% average recovery rating on the leverage loans, 52% recovery on the mezzanine loans and a 50% recovery on high yield bonds. This led to a weighted average recovery rate of 51.5%. **The higher recovery rate assumptions obtained by using the new methodology will not be factored into this research as it would in validate any real comparison between different hedging techniques.**

5.3.3. Collateral and structural elements

Having concluded the analysis of the underlying collateral pool, the focus of the RA switches to the structural features of the CLO. Most of these structural features were introduced in chapter 4: the transactions waterfall and the use of subordination, the way

in which the interest and/or foreign currency hedges work and liquidity considerations (reserve accounts and payment frequencies). These structural elements determine the way in which cash flows are routed through the structure and therefore the risk assumed by the each tranche of notes.

5.3.4. Cash flow modelling

As previously mentioned, absent recoveries and excess spread, the required level of credit support for a CDO tranche would be the gross default rate expected at the desired rating level. This required level of credit enhancement could be worked out relatively easy using basic mathematics. The majority of transactions, however, rely on recoveries and also on excess spread to cover losses. The uncertainty in these factors, predominately the timing of the defaults, makes an analytical assessment of the required level of credit enhancement substantially more difficult if not impossible. Therefore the level of hard credit support for a tranche is in most cases established by running cash flows simulations to verify whether, under the proposed transaction structure, the rated tranches will sustain the commensurate level of defaults and still pay out on their stated terms.

The cash flow simulation usually incorporates the following parameters:

- Transaction structure:
  - Transaction payments priority and triggers;
  - Intrinsic cash flow characteristics of the assets;
- Defaults:
  - Default rate—the expected level of gross defaults;
  - Default timing—when defaults will occur;
  - Default patterns—pattern of defaults that will occur once defaults start;
- Recoveries:
  - Recovery timing—when recoveries will be achieved after a default occurs;
  - Recovery levels—amount of the recoveries achieved;
- Interest rate and foreign exchange curves—different interest rate paths; and
- Default biases.

Some of these parameters are a direct input conform with the transactions structure, while others are determined by the RA to account for potential macro-economic developments and are usually estimated based on historic trends and future projections.

Transaction Structure

As a first step the RA needs to ensure that it obtains or creates an accurate model of the proposed transaction. First and foremost, the cash flow model must accurately incorporate the transaction structure and provisions as per its indenture. The model must replicate the priority of payments as detailed in the transaction's waterfall; incorporate the triggers provided in the transactions and requisite tests. The trigger levels and payment amounts must be calculated as per the definition in the indenture, and the calculation of interest and principal proceeds must also mirror the documentation.

Defaults
The default rate denotes the specific amount of defaults anticipated for the underlying collateral pool used in the structure in a specific rating scenario. The asset pool balance multiplied by the scenario default rate equals the total dollar amount of gross defaults that the transaction must be able to withstand without any loss on a certain rated note. The methodology used to calculate the scenario default rate was discussed under the heading “sizing the default frequency”.

Default rates
The default rate denotes the specific amount of defaults anticipated for the underlying collateral pool used in the structure. The asset pool balance multiplied by the scenario default rate equals the total dollar amount of gross defaults that the transaction must be able to withstand at the given rating. The methodology used to calculate the scenario default rate was discussed under the heading “sizing the default frequency”.

Default patterns
Most CLO transactions are backed by collateral pools of heterogeneous assets. It is therefore very difficult to estimate how much of the collateral will default in any one period. The default rate of the pool defines the expected level of defaults over the life of the pool; however, it provides no indication when defaults will occur. The most drastic assumption is to assume that all defaults occur at once. This, however, is highly improbable because it assumes that all credits are perfectly correlated.

The introduction of default patterns is meant to stress test the structure for potential liquidity issues, especially at senior notes level, which usually have to pay timely, rather than ultimate interest.

For most arbitrage transactions, Standard & Poor's uses a set of standard default patterns to test the transaction. The patterns indicate the percentage of the default rate occurring every year once defaults start. The standard default patterns are as follows:

- 15/30/30/15/10
- 40/20/20/10/10
- 20/20/20/20/20
- 25/25/25/25

Since defaults do not occur in set patterns, the aim of the cash flow analysis is to run different patterns to test the sensitivity of the transaction. In addition to the pattern listed above, Standard & Poor's subjects most transaction to saw-tooth defaults patterns that assume defaults occur every other year or every third year until year 9 or 10 in the life of the transaction. An expected default pattern is calculated by the CDO Evaluator and used in the cash flow model as an additional test case.

Default timing

Default timings refer to when defaults will start in the life of the transaction. As with the default patterns, the non-homogeneous pools of assets used in CLO structures ensures that there is no accurate way to predict when obligors will default. As a result the cash flow model will have to assume different default timings. Defaults may start soon after the deal closes, or may occur after the transaction has been outstanding for a number of years. This is not only driven by the underlying obligors, but also by the ability of the collateral manager to select and monitor credits and ultimately by the economic environment at that time.

Since a fixed dollar amount of assets are being defaulted, the amortization schedule of the asset pool limits how far back defaults can be pushed while still defaulting the entire intended amount. However, as the defaults start later in the life of the transaction, more of the available excess spread would have been paid to the equity holders rather than being used for interest and eventually principal payments on the rated notes. As such the purpose of a shifting default pattern is to test the efficiency of the excess spread trapping and distribution in the structure.

The general default timings used for typical sequential pay transactions consisting of a five-year reinvestment period with a seven year amortisation profile are as follows:

- For deals with weighted dollar average life of 7.5 to 9 years, the specific default patterns starts in year 1, and the patterns is repeated starting in every year thereafter, up to and including the last year of the reinvestment period.
- For deals with weighted dollar average life of greater than nine years, continued with defaults starting in first year of amortization period, and pushed back as far as possible while still defaulting the entire original dollar amount.
- For deals with weighted dollar average life of less than 7.5 years, the start of defaults is pushed back as far as possible during the reinvestment period, while still defaulting the entire original dollar amount.

Box 4: North Westerly III CLO example

For the North Westerly transaction, given its 6 year reinvestment period and 15 year amortisation period, this means that the specific default pattern will start in year 1 and is repeated up to and including year 9.

Modelling defaults

Having established the default rate, pattern and timing we can calculate how many assets will default and when these defaults will occur. In modelling the defaults Standard & Poor's assumes that defaults occur at the end of each period modelled (usually the notes payment periods), with no interest being earned on the defaulted amounts in the period when they default or thereafter. It is not expected that an obligation would pay interest just before defaulting. The loan documentation typically defines an event of defaults as failure to pay, and there are very few instances where defaulted obligations stay current on interest while defaulting on principal. Thus, no interest is paid or earned on the

defaulted amount for and in the period that it defaults. Interest is earned only on the performing pool balance.

Recovery rates and timing

The defaults a structure experiences constitute a loss of interest and an outflow of principle, the recoveries in contrast create an, albeit smaller, inflow of principle. These recoveries can be used for reinvestments or redemptions, creating a fresh stream of interest or reducing the structures liabilities. S&P assumes that recoveries are made within one period after the default.

The amount of money recovered upon a default is depended on the recovery rate. The recovery rates used in the cash flow model are a direct input, determined based on the collateral pool as mentioned under “sizing the loss severity”.

Interest and foreign exchange rate stresses

Knowledge of the characteristics of the underlying collateral and the usage of RA assumptions regarding the behaviour of the assets are, however, not sufficient to predict the future performance of a CLO structure. The performance of most transactions is influenced by certain macro-economical developments, such as interest rate movements and change in foreign exchange rates.

Some CLO transactions suffer from a fixed and floating miss-match, where fixed interest rates are received on the assets and floating rate interest payments have to be made on the liabilities, or visa-versa. Most transactions will try to hedge these miss-matches using swaps or option contracts. To test whether these hedges are able to protect in different interest rate environments, the RA applies various interest paths to stress the transaction’s structure. In general S&P applies the following index scenarios:

- Index up
- Index down
- Index up/down
- Index down/up
- Forward curve

In addition to running interest rate sensitivities to test fixed-rate to floating-rate mismatch, if the transaction warrants it, Standard & Poor's will test foreign currency risk that requires modelling of different currency curves and different interest rate indices. If the FX risk is not totally hedged, Standard & Poor's applies cross-currencies appreciation and deprecation curves that can also be modelled into the transaction.

For the test structures, which do not totally hedge the FX-risk, this means that additional stresses will be included to assess the effect of changes in the FX-rate and LIBOR rates. These stresses include:

FX-rate stresses:

- Index up
- Index down
- Forward curve

LIBOR stresses:

- Index up
- Index down
- Forward curve

The future value of the interest and FX-rates used in these index scenarios are estimated using historic data and the current forward curves. By applying stresses and using probability models the rating agency calculates a confidence interval for the values, such that the probability that the future value will fall within the determined range is sufficiently high.

The values of these curves used while modelling the cash flows for the test structures are included in appendix A.7, A.8 and A.9.

Default Bias

Most CDO transitions are modelled based on the general pool characteristics and on a pro rata default across all asset assets. This is a fairly good modelling technique in most circumstances. If, however, the asset pool composition can shift substantially over time, it might be appropriate to test certain biases in default.

Given the flexible nature of multi-currency structure incorporating VFNs, S&P's has indicated that it will bias defaults towards the assets denominated in a foreign currency for stress testing these transactions. By increasing the defaults in the foreign assets S&P amplifies the risk related to FX and interest mismatches as the income on the foreign asset will no longer be sufficient to pay for the foreign liabilities.

The default bias used by S&P for these transactions is as follows:

$Default\ in\ foreign\ assets = \frac{2\beta}{(1+\beta)}$, Where β is the percentage of foreign assets.

Box 5: North Westerly III CLO example

The original North Westerly transaction allows for a bucket of 35% non-European obligations. If this bucket was fully used, this would mean that 51.85% of all the total amount of defaults would occur in the foreign assets. Provided that the NWIII uses only 15% foreign denominated assets, the default bias will translated in 26.08% of the total number of defaults occurring in the pool of foreign assets. In order words, if the total default rate surpasses 57.5%[19] all the foreign assets are assumed to have defaulted.

[19] 26.08% of the total number of defaults expressed in their value in Euros will occur in the pool of foreign assets. The total number of foreign assets amounts to 15% of the total asset portfolio,

5.3.5. Testing the proposed structure

The modelling and stress testing of a CLO is driven by the assumption that a CLO is essentially nothing more than sum of its future cash flows. Even though CLO can consist of complex financial structures, none of them practises the art of financial alchemy; the income of the CLO should be sufficient to pay for its expenses.

To provide their opinion on the likelihood that a given CLO structure will be able to fulfil its interest obligations and return its principle in a timely manner, the RA makes an assessment of the underlying collateral pool and the cash flows under various stress scenarios based on the parameters discusses above.

In other words, by using cash flow simulations the rating agency tries to account for the inherent uncertainty in the estimation of the future value of the parameters underlying these scenarios. It assumes that by creating a scenario for each possible combination of estimates for future values and using these as an input in the CLO model, it is able to assess the commensurate level of default that the CLO structure is able to withstand at each tranche given the used combination of variables. This maximum percentage of defaults a collateral pool can sustain and still pay ultimate principle and all due interest (timely or capitalized) to a certain tranche is called the break-even default rate or "BDR" of that tranche. Mind that for each trance there will be several BDRs, for each cash flow scenario. If a large enough percentile of the BDR distribution, depending on the rating, is higher than the SDR at a certain rating, the CDO tranche is deemed able to withstand the level of default stress at the desired rating category. Table 5.8 summarises the BDR percentiles applicable for each rating category.

Table 5-8: BDR percentiles per rating

Break-Even Percentiles By Rating

CDO tranche rating	Percentile
AAA	5th
AA	10th
A	35th
BBB	50th
BB	60th
B and lower	70th

Note: The CDO tranche or liability rating categories below 'AAA' include rating subcategories, e.g., the 'AA' row also applies to CDO tranches rated 'AA+' and 'AA-'.

Given the nature of the percentile approach there is the implicit risk that a structural weakness in the proposed CLO structure goes unnoticed; the CLO might be able to achieve the required BDR for the desired credit rating as the scenarios in which this weakness is stressed are discarded. To prevent the CLO from showing any structural

hence when the 26.08% of the total value of the defaults equals this 15% all the foreign assets are assumed to have defaulted. This results in 15%/26.08% = 57.5%.

weaknesses the discarded BDRs under the percentile approach are carefully reviewed to determine whether the CLO structure is particularly vulnerable to any specific parameters.

When the rating agency, in this case S&P, is confident that no such structural weaknesses exists and that the proposed CLO structure is able to achieve the SDRs for each rating scenario, the RA will provide its opinion and assign the ratings to the various tranches of the structured financial product.

5.4. Conclusion

In the previous sections an elaborate overview of the NWIII CLO was presented. The structural features mentioned in this overview will serve as the base case for the development of the test-structures. The North Westerly III is a “classic” multi-currency CLO issued by NIBC in 2006 and uses a perfect asset swap to hedge its foreign currency risk. As such, this CLO does not only serve as a good starting point from a modelling perspective but also as a good starting point for the comparison between the various hedging techniques.

Except for the hedging strategy, the differences in the priority of payments and issued notes, all the information presented here will apply towards the test-structures created in section 4.4.
To be able to assess the performance of the different test-structures, these structures will be tested using the Standard&Poor’s rating methodology. This rating approach was elaborately discussed in the second part of this chapter. It was found that most of the methodology used in testing the NWIII is directly applicable to the testing of the 8 proposed structures. The test-structures will, however, be more severely stressed with regards to the inclusion of multi-domestic assets which are not perfectly hedged.

In the next chapter the S&P rating methodology will be used on the test-structures to determine their resilience against FX and interest rate movements while the rest of the test parameters are identical to those used in testing the NVIII structure. And finally the ROEs of the various structures will be determined to conclude which structure provides the most benefits.

6. Results

6.1. Introduction

Adhering to the logic set out in section 4.5, a comparison of the relative performance of the test-structures should be based on their return on equity, provided that they are backed by the same portfolio and only structural differences have an impact.
In general a ROE estimate is the end result of a structuring process, obtained by running the equity scenarios on the final structure. To be able to assess the return on equity for each of the test-structures, they will first have to be captured in a cash flow model. Each structure will be stressed using the rating agency's assumptions and scenarios, in order to optimize the tranching and other parameters of the transaction while still passing all the tests. The optimised tranching, together with the required number of American options and minimum required strike price will finally be inserted in the model and used to determine the potential returns on equity by running the equity scenarios. Thereby providing an answer to the fifth and final research question:

5) *Which hedging structure which uses a multi-currency revolver provides the most efficient hedge for our base case CDO?*

In order to accomplish the above, the methodology used in stress testing the test-structures will be discussed in section 6.2. This methodology will be applied to the test-structures and the results of running the various simulations will be presented in section 6.3.

6.2. Stress testing the test structures

6.2.1. Creating the cash flow models

The eight test-structures developed in section 4.4 are largely based on the original North Westerly III CLO. They will use the original NWIII collateral pool and will apply the same covenants as indicated in the original indenture, a summary of which is included in chapter 5. Each of these structures is subjected to similar recovery rates, average spread and trigger levels. Each of these structures is subjected to similar recovery rates, average spread and trigger levels. Here it should be noted that the average spread on the portfolio used in the test-structures is 9 basis points higher than the spreads used in the original NWIII, as a result of eliminating the PAS.[20] The various structures do, however, differ from each other with respect to the priority of payments and the upfront costs related to the required number of options.

[20] The 9 basis points increase in average spread are the result of the elimination of the PAS agreement previously used on foreign denominated assets, constituting 15% of the total amount of assets. The PAS agreement lowered the spread on this 15% of assets with 60 basis points. Removing the PAS would therefore result in an average spread of 85% * 275 bp (the original average spread) + 15%*335 bp (275 +60) = 284 bp, an increase of 9 bp.

To evaluate how these differences influence the performance of the test-structures, the existing North Westerly cash flow model has been amended so that it is able to accommodate the structural features deduced in section 4.4. This cash flow model will receive inputs from the scenario runner in order to assess the impact of the different rating scenarios on the performance of the structure and will calculate the loss level at each rated note. The scenario runner is an excel model used by NIBC to run different rating scenarios. This program inserts the variables related to a specific rating scenario into the cash flow model and determines iteratively the break even default rate for that scenario.

For the test-structures to be an improvement of the existing NWIII structure, these structures should at least be able to sustain a similar BDR at each rating level, cetris paribus. The BDR calculated by the scenario runner is the default level the tested tranche of the test-structure is able to resist without any dollar of loss. Given that all the structures are tested using the same scenarios, collateral portfolio and covenants, this BDR level translates to the amount of risk the tranche is able to assume.
To be able to compare the ROE, each tranche of the structures should be able to assume a similar degree of risk and should therefore be able to attain a similar BDR level, with the original BDR of the NWIII as a minimum.
When the required BDR of a certain tranche is not met, the subordination at that level is increased, usually by decreasing the size of the tranche. However, as has been repeatedly mentioned throughout this paper, costs and ratings move in parallel. It follows that if the higher rated tranches narrow while the lower rated tranches widen the weighted average cost of the liabilities will increase accordingly. This will reduce the return on equity, which in turn would diminish further when the size of the equity itself increases.[21]
There is a significant probability that a respective test-structure has to be augmented with a number of long date American Options to hedge the transaction against excessive FX movements. Purchasing these options results in an additional upfront charge which increases the size of and reduces the return on equity. **Therefore those structures which are not able to make the minimum BDR level will be discarded as the structural elements used in them do not result in more efficient capital structures.**

The minimum default levels a tranche has to be able to sustain in order to qualify for the desired credit rating is usually indicated by the transactions test matrix. Table 6.1 displays the test matrix used for the original NWIII transaction. The test matrix is a transaction specific table created by the rating agencies indicating the minimum SDR a transaction has to be able to achieve to qualify for a specific rating given its weighted average spread and expected recovery rate. The reason why test matrixes are used in a CLO indenture, instead of a single value for the SDR, is that they provides more flexibility to the Collateral Manager in managing the asset pool while allowing for smaller buffers

[21] One might argue that it should be possible to improve the BDR by including additional credit enhancements. Incorporating credit enhancements into the test-structures is, however, not an option as it would change the nature of the structure and thereby invalidate any comparison between the different structures researched in this thesis.

between the covenanted and actual parameters of the asst pool. During the reinvestment period the collateral pool in the CLO is replenished with assets. Even though new assets have to fulfil the requirements set by the portfolio profile and quality tests, it is unlikely that these assets precisely match the averages of the then current asset pool. As such the average spread and recovery rate might slightly change[22]. To prevent the collateral manager from going back and forth between the asset market and the rating agencies to get a different SDR value for every change in the recovery rates and average spread due to an asset purchase, a matrix stipulating the SDRs for slightly different values of these variables is included in the indenture.
In addition the test matrix provides an assurance to investors as to the minimum SDR the tranches will be able to sustain given a potential change in the collateral pool.

The marked line indicates the SDR levels per credit rating which each of the test structure should be able to sustain given the average spread and recovery rate of the base case portfolio.

Table 6-1: NWIII Test matrix

Case	Minimum Weighted Average Spread	Minimum Weighted Average Recovery Rate	Break Even Default Rate				
			Class A1 Notes	Class B1 Notes	Class C1 Notes	Class D1 Notes	Class E1 Notes
1	255	54%	58.32%	45.58%	39.33%	34.11%	28.59%
2	255	56%	59.67%	46.57%	40.15%	34.95%	29.38%
3	255	58%	61.08%	47.39%	41.14%	35.66%	30.21%
4	255	60%	62.43%	48.25%	42.18%	36.76%	31.08%
5	265	52%	57.35%	44.92%	38.89%	33.18%	28.43%
6	265	54%	58.64%	45.95%	39.48%	34.62%	29.19%
7	265	56%	59.99%	46.95%	40.56%	35.46%	29.99%
8	265	58%	61.40%	47.77%	41.55%	36.35%	30.84%
9	275	50%	56.42%	44.07%	38.68%	33.15%	28.29%
10	**275**	**52%**	**57.66%**	**44.82%**	**39.38%**	**34.32%**	**29.02%**
11	275	54%	58.95%	46.31%	39.97%	35.13%	29.79%
12	275	56%	60.31%	47.32%	40.71%	35.66%	30.60%
13	285	48%	55.70%	43.67%	38.40%	33.30%	28.22%
14	285	50%	56.73%	44.47%	39.19%	34.04%	28.90%
15	285	52%	57.97%	45.23%	39.76%	34.81%	29.60%
16	285	54%	59.27%	46.10%	40.61%	35.62%	30.38%
17	295	46%	54.86%	43.22%	38.29%	33.06%	28.17%
18	295	48%	56.00%	44.02%	38.88%	33.77%	28.81%
19	295	50%	57.04%	44.88%	39.55%	34.52%	29.50%
20	295	52%	58.28%	45.64%	40.24%	35.30%	30.21%

[22] The collateral manager also has the option to include assets using a different payment profile, such as payment-in-kind (PIK) assets. Including these assets would require a different matrix all together.

To determine whether the BDR of the test structures is sufficiently higher than the SDR, in this research the S&P rating methodology is used to create a total of 525 scenarios (7 default patters * 5 domestic interest rate indices * 5 foreign interest rate indices * 3 FX-rates indices) per rating level (figure 6.1). For most of these scenarios there were sub-scenarios in which the default pattern started between year 1 and year 9. The structures were further stressed by the introduction of a default bias. This bias increased the number of defaults among the assets with an appreciating currency, making it harder to cure any potential FX-mismatch.

Running all the scenarios resulted in a staggering 20,000 data points per rating level per structure. Computing all these data points is hugely resource intensive; running the cash flow model for each individual structure would take an average computer in excess of 72 hours. Therefore an attempt was made to significantly cut back on the number of scenarios to be run for each structure.
A reduction of the number of scenarios should be warranted due to the nature of the various scenarios. Not each scenario is expected to be equally stressful; some scenarios use the expected forward curves, while other use stressed curves derived from these forward rates. Common sense dictates that the latter should be more stressful than the prior. In general three factors determine the majority of the stress level of a scenario:

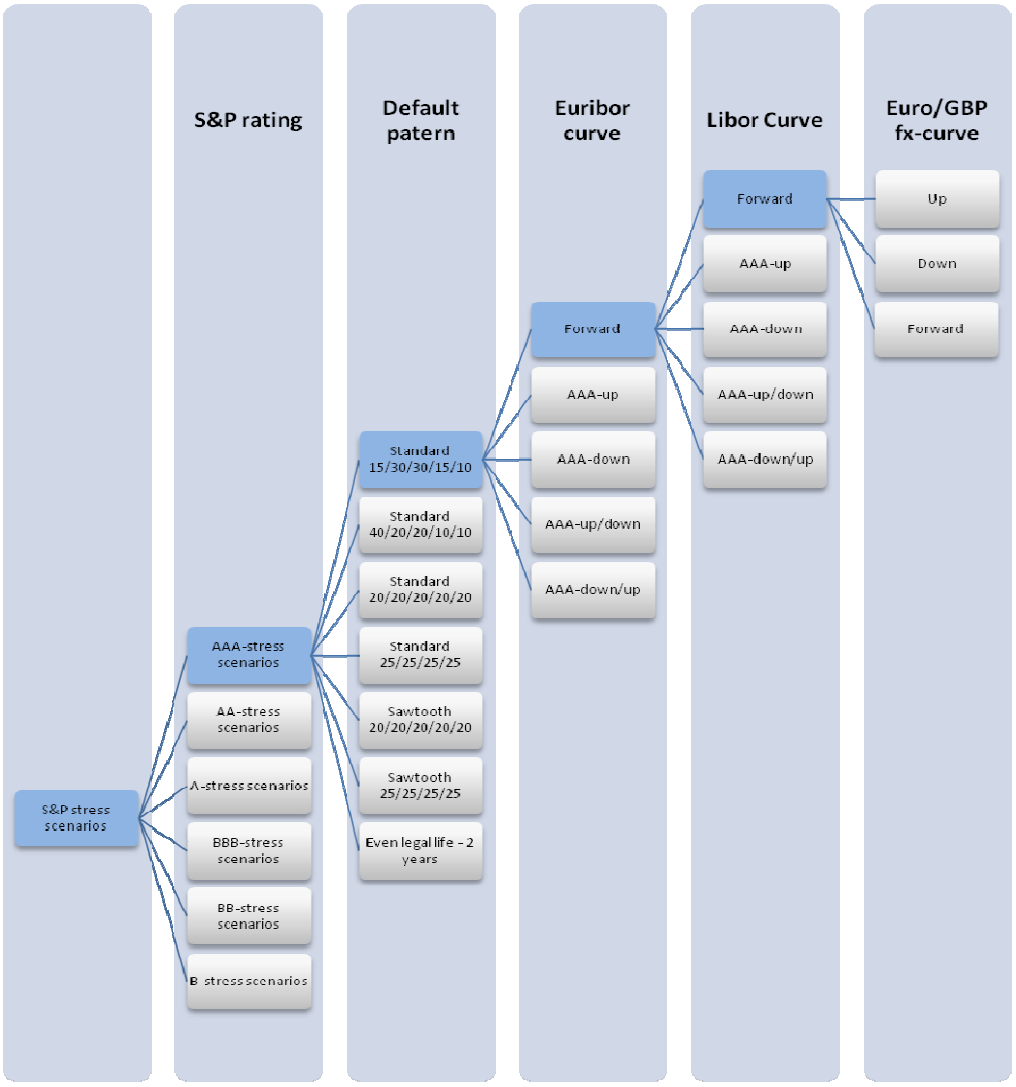
- The default timing; defaults occurring early in the life of the transaction are less stressful for the senior rated notes, as the recoveries will usually be used to redeem notes and therefore ensure an early return of principle to the rated note holders;
- The shape of the indices; the flat forward curves for both the future interest rates and the FX-rate are significantly less stressful for the average CLO than widely fluctuating indices or indices running in opposite direction; and
- The rating; The SDR which a note needs to achieve is directly related to the desired credit rating. The higher the credit rating the higher the required SDR. At the same time achieving these higher SDRs is made progressively harder by the rating agencies by applying more stressful indices. Therefore testing the most senior, usually triple-A, tranche means that the structure is exposed to the most severe stress criteria and has to attain the highest SDR.

To determine which scenarios were most stressful for a multi-currency structure, a test run was performed on a structure using a pari-passu ranking VFN a pro-rata payment allocation and no redenomination. This test run included all the triple-A scenarios and default timings. Based on these results, the 20% most stressful scenarios were selected. These scenarios will be used as input for the subsequent stress tests performed on the test-structures.

To determine whether a given structure is eligible for a specific credit rating the rating methodology used by S&P dictates that a specific percentile of the total number of

scenarios should be passed, table 6.1. To be able to achieve a triple A rating, the senior tranche should show a BDR higher than the calculated SDR on 95 out of a total of 100 scenarios. In other words, 5 out 100 scenarios can have BDRs lower than the SDR, and be discarded. By selecting the 20% most stressful scenarios, this percentile would increase to 25%, e.g. 5 out of every 20 scenarios could be discarded.

Figure 6-1: structure of the rating scenarios used by S&P



6.2.2. Optimization of upfront costs

During the cash flow simulations the test-structures will be exposed to FX- and interest rate risk, both emanating from defaults occurring in the assets denominated in the foreign currency. The test-structures can be augmented with American options to hedge the FX-risk; however, the interest rate risk is left unhedged. Prior to running the scenarios it is impossible to tell if a structure requires any options and, if any options are required, how many and at which strike price. Therefore the initial cash flow simulations will assume that the test-structures are in the possession of an indefinite amount of *at the money* American Options[23]. The structures will not be allowed to sell any currency options, to prevent any currency speculation; scenarios with an upwards moving foreign exchange index, appreciating Sterling, could potentially obtain an indefinite amount of money by selling the indefinite options in their position. Obviously this would invalidate any real comparison.
Including the at the money American options basically eliminates the FX-risk resulting from an increasing Euro/Sterling foreign exchange rate, however leaves the interest rate mismatch untouched.
In other words, the initial run will test the vulnerability of the test-structures with regards to the risk resulting from the interest rate mismatch.
If a given structure is able to achieve a sufficiently high BDR for at least 25% of the total number of scenarios included in this initial run, the proposed structure is assumed to be sufficiently robust with respect to the interest rate mismatches. **The structures which fail to meet this criterion will be discarded as it is very unlikely that these structures provide an improvement compared to the original NWIII.**

The remaining structures will be further tested with regards to their vulnerability to FX movements. The initial run assumed that each of the structures possessed an indefinite amount of options. While this surely would provide sufficient protection against FX movements, the upfront cost related to purchasing these options would result in a negative return on equity. Therefore a reduction of the amount of options included in the structures will be the next step. However, the cost related to buying the options does not solely depend on the amount of options used in the structure, but also on the strike price. Optimising the structures therefore calls for a reduction in the amount of options while possibly increasing the strike price per option up to and until the structure fails to meet the required BDR.

Intuitively it should be possible to work out an analytical solution to the trade off between increasing the strike price and reducing the number of options. The upfront cost shares a linear relationship with the number of options included in the structure; each option contributes an equal amount to the upfront cost. The relationship between the strike price and the upfront cost could be approximated analytically, albeit that this relation is

[23] It was already mentioned that the minimum strike price used in the simulations would be the closing date spot exchange rate. Using a lower rate would basically equate to increasing the equity used in the structure in the form of a buffer account.

significantly more difficult to establish due to the inherent difficulty with valuating American options. Comparing the graphs of the first order derivatives, it might be possible to determine an intersection between the two options. This intersection hypothetically would indicate the point from which choosing one of the options provides a higher benefit compared to the other. For example, up to point α reducing the number of options used in the structure might provide the largest reduction in the upfront cost. As such this option would be favoured over increasing the strike price. From point α onwards the strike price might provide the largest reduction of upfront costs and this option should be favoured. Obviously the two derivatives might have multiple intersections or none at all, meaning that the preference for either one of the options varies depending on the situation or one of the options is always favoured above the other.

Using this analytical approach on all the scenarios is, however, very time consuming and computational intensive. Furthermore, the efficiency of determining the optimal solution for each of the test-structures per rating scenario might be limited. The S&P rating criteria stipulate that at least 95% of the rating scenarios should be passed in order for a tranche to qualify for a triple-A rating. Therefore the highest possible strike price[24] and lowest number of options which could be used should be high enough such that 95% of the structures could pass. Reviewing the strike prices and number of options in pairs would result in a higher than necessary strike price and a higher than necessary number of options; the maximum of both would have to be chosen.
Therefore this approach has been disregarded in favour of a much simpler approximation. This approximation consists of a simple simulation which first searches the minimum required strike price such that 95% of the scenarios pass the SDR. A second simulation is used to determine, given the minimum strike price, how many options need to be included in the structure.

The first test was performed using a model called “the strike price runner”. This model is an adapted version of the scenario runner which does not perform iterations on the default rate in order to determine the BDR, but performs iterations on the strike price while keeping the default rate fixed in order to determine at which strike price the structure suffers its first loss. Running the model results in a table of numbers indicating the minimum strike price[25] required for a specific scenario in order to meet the required default rate. Simultaneously this model shows the amount of options used at the calculated strike price.
To test the structures resilience against FX-movements this test was performed by running only those scenarios which apply an increasing Sterling index; these scenarios are most severely exposed to movements in the FX-rate and options are more likely to be necessary to limit this exposure. In other words, only those scenarios were selected which during the life time of the transaction experience an appreciation of the Sterling against the Euro. This resulted in a run including 177 different scenarios with varying default timings.

[24] measured as the percentage increase relative to the spot rate

[25] The minimum required strike price is here defined as the minimum diversion from the spot rate.

Interpreting the results obtained by running this model is somewhat complicated. Recall that the S&P methodology stipulates that at least 95% of the total number of scenarios should be able to achieve a BDR higher than the SDR. Consequently, the strike price might not have to be the absolute minimum as some of the scenarios could be allowed to fail. By purposely allowing additional scenarios to fail the upfront cost could potentially be reduced. The 5% of the scenarios allowed to fail the minimum BDR requirement consists, however, of scenarios with upwards moving Sterling indices as well as down wards and flat curves. Therefore there is no way to determine with absolute certainty for how many of the scenarios included in this run this is the case without doing iterative runs with the strike price runner and the scenario runner.
A good approximation can be obtained by looking at the initial run preformed to assess whether the structure was able to meet the minimum BDR requirements. By counting the number of scenarios which were not able to meet the minimum BDR requirements, the maximum number of additional scenarios which could be allowed to fail without jeopardising the BDR requirements can be calculated. Among the scenarios which already failed the initial test, there might be some scenarios including an upward moving Sterling index. These scenarios should be added to the additional structures allowed to fail.
As such the maximum number of additional scenarios which could be allowed to fail is:

Max. additional scenarios allowed to failed = *5% of the total number of scenarios – scenarios failing to meet the BDR + failed scenarios including an upwards moving Sterling index*

After sorting the scenarios based on their minimum strike price requirements, the calculated number of scenarios can be discarded. If there are multiple scenarios with a similar strike price those scenarios which fail to make the BDR requirements will be discarded first. These scenarios should be selected manually by comparing the failing scenarios in the initial run to the current results.
Second the scenarios should be ranked based on the number of options each scenario uses, as each additional option increases the initial cost, those structures using the most options will be discarded. The lowest strike price remaining in the sample will than indicate the minimum strike price required by the structure.

Finding the minimum strike price is, however, only step 1 in the optimisation of the upfront cost. It is possible and even likely that the scenario requiring the lowest strike price does not use the maximum number of options. Probably some of the structures which can sustain a higher strike price but use a large number of options allow for a reduction in required number of options if a lower strike price is used.
To test the minimum number of options exercised in each scenario a third model was created: the option runner. This model is a further modification of the scenario runner, which uses a fixed strike price and fixed BDR while performing iterations on the number of options. The model determines the minimum number of options the structure requires to pass the minimum cumulative default rate of 60&% given a fixed strike price.

In this second step the percentile approach of S&P does not apply and no further structures should be allowed to fail[26]. Therefore the maximum number of options needed by all the initially passing scenarios to meet the BDR requirement is the minimum number of options the structure should include. The determination of the minimum number of options required by a structure concludes the optimisation of the upfront costs.
To check whether the obtained solution does indeed meet the minimum BDR requirements, the structure is finally subjected to a full test run with the scenario runner. This final run consists of all the triple-A scenarios and uses the calculated strike price and number of options. If the structure is not able to meet the minimum BDR requirements or when it passes this requirement with a significant margin, the strike price and number of options will have to be adapted as per the two step methodology described above.

In summary the steps taken to minimise the upfront cost are:

- Running the strike price runner on the scenarios with an appreciating sterling index to find the minimum strike price each scenario needs to pass the BDR requirements;
- Calculating the maximum number of scenarios tested in this second run which could be allowed to fail the BDR requirements ;
- Determining the minimum strike price;
- Optimising the required number of options; and
- Testing whether the calculated solution is indeed able to sustain the required BDR.

6.2.1. Optimisation of the tranching

Thus far the tests performed on the structure focused on the most senior liabilities, here the triple-A notes. The first tests were aimed at ensuring that the risk of the most senior tranches in the test-structures and in the NWIII structure is similar, while their sizes remain equal. In the second test the optimal option strategy was determined in order to reduce the upfront cost incurred by the structure.
The next step in optimising the test-structures with respect to the liabilities costs is to improve the structure's tranching, starting with the second most senior rated tranche.
The size of the most senior tranche has been kept fixed during the optimization of the upfront costs in the previous section. The size of the senior tranche in all of the test-structures equals the size of the senior tranche in the NWIII.
By increasing the size of the higher rated notes, while decreasing the size of the lower rated notes and equity, the weighted average costs of the liabilities in the structure can be reduced. The size of the junior tranches is determined in an iterative process starting from the most senior of these tranches towards the most junior tranche. The size of, for example, the most senior of the junior tranches (which in this thesis will be referred to as

[26] The minimum strike price was already determined by calculating the maximum number of scenarios allowed to fail under the S&P percentile approach. Therefore by further allowing any scenarios to fail by reducing the number of options below the minimum requirements would jeopardise the BDR requirements.

the second senior tranche or “SST”) is basically determined by varying the subordination level of the tranche at the expense of its size in an iterative process in order to preserve the BDR in NWIII. Three factors are kept constant at each step in the process: the size of the transaction (sum of the sizes of all rated notes), the size of the senior ranking notes and the level of upfront costs.

To estimate the required level of subordination need by the SST in order to achieve the desired rating level, the SST’s BDR is compared with the SDR levels calculated for the NWIII (table 6.1). The BDR of the SST is tested using the scenario runner. This is the same model which was used to test the BDRs for the senior notes. The model will iteratively increase the default level used in the selected scenario in order to determine at which level the tested tranche experiences its first dollar of loss. The scenarios ran in testing the junior rated notes are usually less severe than those used to test the most senior notes due to the lower rating level desired for these tranches. The interest and FX indices for the junior scenarios can be found in appendices A6, A7 and A8.
Even so, the BDR for the junior tranche is usually lower than that for the senior tranche. This is due to its subordinated ranking, in other words the junior tranches will only receive their interest and principle payments after the senior tranches have been paid and are therefore more exposed to a default than the senior rated notes.

In order to preserve the risk in NWIII at all rated notes in the new structures, an iterative process used in which the size of the SST is varied in order to achieve the desired BDR. An increase in the size of a tranche on the expense of the subordination to that tranche lowers the BDR at that level while a similar decrease of the size increases the BDR. After each such change in the size of a certain tranche the BDR is calculated and the process is repeated until the desired BDR is obtained. For the sake of computation time, this research will use an approximation to establish the SST size. After calculating the SST’s BDR, the SST will be increased (decreased) by a significant margin, such that it is likely to fail (pass) the minimum BDR requirement. By linear interpolating between the two values, the tranche size is estimated. This number will be rounded to the nearest half a million.

This process is repeated for each of the junior rated notes, down to the lowest rated note. After having determined the size of all the tranches after the calculation of the strike price and amount of options in the previous step, the liability structure should have been optimised and the return on equity can be calculated using the equity scenarios.

6.2.2. Description of the equity scenarios

To sell the equity piece of the CLO structure, the issuer usually embarks on a road show in which they present the proposed structure to equity investors. An important part of this pitch is the results for the return on equity in certain standard scenarios.
The equity scenarios are a number of stress scenarios created by the issuer using only those future values of the rating parameters which can realistically be expected. This usually means that the issuer will apply scenarios with the quoted forward rates for the interest and FX indices in the market, slightly relaxed default rates and higher recoveries

in comparison with the values assumed by RA. Running these scenarios results in the expected return on equity given the scenarios assumed by the issuer.

Table 6-1 presents a side by side comparison between the assumptions made in the equity scenarios used in the investor presentation for the original North Westerly III structure and the assumptions made by S&P in rating this structure. There are a number of fundamental differences between the S&P rating assumptions and the assumptions used in the equity runs. For example the underlying asset collateral used in the equity scenarios assumes 90% senior secured debt obligations and 10% second secured debt obligations compared to a 100% senior secured debt obligations in the S&P rating scenarios. In addition, in the equity scenarios the defaults start after one year, recoveries are increased to 75% and 55% respectively (one year lag to recovery) and the underlying asset collateral's weighted average spread is increased to 285 bps on senior secured debt obligations and to 500/450 on second secured debt obligations (current component and PIK component respectively).
These equity assumptions will form the basis for the ROE calculations, the results of which will be presented at the end of the next section.

Table 6-2: Settings equity scenario

	Equity
Assets - Leverage Loans	
% of the pool	90,0%
margin	294
recovery	74%
timing of recovery - when	month 12
- how much	100%
	month 0
	0%
Assets - Mezzanine	
% of the pool	10%
margin - cash	500
margin - roll-up	450
margin - warrants	0
recovery - mezzanine	55%
recovery - mezzanine roll-up	55%
timing of recovery - when	month 12
- how much	100%
	month 0
	0%
Assets - High Yield Bonds	
% of the pool	0,0%
Type - fixed ONLY!	Fxd
margin / coupon (bps)	850
recovery	30%
timing of recovery - when	month 12
- how much	100%
	month 0
	0%
Structure	
ramp-up period	Yes
use original balance for defaults	No
use reinvestment sub-pools for defaults	Yes
reinvest unscheduled principal after reinvestment period	No
prepayments	25%
spread on accounts y1	-25
spread on accounts after y1	-25
senior collateral manager fee (bps)	15
cumulative default rate	30,0%

6.3. Running the cash flow models

In accordance with the methodology described in the previous section the structures created in chapter 4 were first tested with regards to their resilience against interest rate mismatches. Testing of the impact of the FX movements came second and only occurred for those structures which had proven to be able to cope with the unhedged interest rate mismatch.
As discussed in the previous section, an initial test was run on a structure using a pari-passu ranking VFN, a pro-rata cash flow structure and no redenomination to determine the 20% most stressful triple-A scenarios, the “stress-scenarios”. This resulted in 585 scenarios which were used in the subsequent BDR tests.

6.3.1. Options assumption

To reduce the amount of time required to amend the cash flow model such that it could accommodate the test-structures and to reduce the number of calculations which the model had to make to run the scenarios, the first version of the cash flow model included a number of assumptions with regards to the use of the currency options.
In this initial version of the cash flow model the benefit of using the currency options in each notes payment period was calculated only after they have been used and added to the cash inflow of the next payment period. Practically the entire waterfall has been modelled in a single currency (EUR) with the GBP Euro equivalent of the proceeds, assets and liabilities accounted for at the then FX rate. In this way just one currency conversion has been modelled rather than all potential conversions at each note level. One would not have to keep track of the number of options used through the structure, but do just one count in each period.

For the cash flow model this assumption basically meant that the amount of options used in each period was calculated by reducing the amount of euro converted to sterling by the amount of sterling converted to euro, with a minimum of zero. If the options strike price was lower than the prevailing spot, and if any options were still available, they would be exercised to lower the cost of converting EUR to GBP. As this calculation was made at the end of each period the money saved on this conversion had to be added in the subsequent period. It was chosen to recycle the money as principle proceeds available in the next period. This choice was directed by its higher versatility. In contrast to interest, principle cannot only be used to cure any shortages in interest, to reinvest or to redeem notes, but also to facilitate redenominations.
The next step was to assess the impact of the approximation described above on the predicted FX-resilience of the CLO structure.
The model was further developed to keep separate track of the proceeds in both currencies throughout the structure. All potential FX conversions were modelled at the level where they would be performed in the waterfall. They can be made by exercising options or not, depending on the FX rate relative to the options strike price and on whether options are still available or not. It was found that the impact of accounting for the benefits of using FX options at each conversion throughout the structure was rather large. On the one hand delaying the use of the savings obtained by using options meant

that in some scenarios the structures were unable to redeem or reinvest up to their full potential. As such they either had to pay a higher level of interest or received less interest on their asset portfolio; both proved significantly more stressful than originally anticipated. On the other hand, in scenarios with a fluctuating or upwards sloping FX rate[27] the stress was severely lowered. In these scenarios it could happen that the options would be exercised in period "α" to convert an amount of euro to sterling at a very high FX rate. The Euro savings obtained by exercising the options would be added in period "β" in which the FX rate decreased significantly. As such the GBP equivalent of this Euro principle inflow would be a lot higher in period "β" than in period "α" and consequently could be used to redeem much more notes.
Both these effects are highly undesirable and surely did not contribute to the validity of the tests performed in this research. Therefore the cash flow model including this assumption was discarded in favour of the cash flow model which more accurately described reality. The cash flow model used in the final analysis calculates at any FX conversion how many options are used and limits the Euro costs accordingly. The structure employs the savings obtained by exercising the options to redeem or reinvest in the same period as when the options are used, consequently achieving accurate results.

6.3.2. The results

The updated cash flow model was subsequently used to test the performance of the test-structures. The results are presented in table 6-3.

Table 6-3: Test results

Structures	Spread in BP	Ranking VFN (Senior/Pari-passu)	Payment allocation (Like-for-like/Pro-rata)	Redenomination (Yes/No)	Break even Default Rate (5% percentile)	BDR >= Base Case (Pass/Fail)
Base case structure		n/a	Pro-rata	n/a	60.00%	n/a
structure 1	284	Senior	Like-for-like	Yes	46,01%	Fail
structure 2	284	Senior	Like-for-like	No	45,51%	Fail
structure 3	284	Senior	Pro-rata	Yes	39,28%	Fail
structure 4	284	Senior	Pro-rata	No	38,90%	Fail
structure 5	284	Pari-passu	Like-for-like	Yes	57,62%	Fail
structure 6	284	Pari-passu	Like-for-like	No	55,48%	Fail
structure 7	284	Pari-passu	Pro-rata	Yes	39,08%	Fail
structure 8	284	Pari-passu	Pro-rata	No	38,70%	Fail

Interestingly, the results of this run show that none of the 8 test-structures were able to reach the required SDR. This result came as somewhat of a surprise as the structures tested in this replicate the structures which were actually found in the market. Obviously, the test-structures offer a qualitative improvement compared to the original NWIII due to

[27] Where the FX rate is assumed to have an upwards slope when the Sterling appreciates relative to the Euro.

the increased flexibility offered by the VFN. Nevertheless, it was expected that at least some of the structures would also show a quantitative improvement compared to the NWIII. One could speculate on plausible reasons as to why these structures failed to pass the test. For example: lower recovery rate assumptions, different characteristics of asset pool, spread assumptions etc. It goes too far to discuss them here. A detailed discussion will therefore be postponed for the next chapter.

Some of the structures, most prominently structure 5, are relatively close to reaching the threshold level. Optimizing this structure could potentially provide some benefits relative to the original NWIII, so further testing seemed warranted.
The reasoning behind testing the triple-A BDRs at first is that structures with a higher percentage of AAA notes are usually more beneficial for equity returns because the liabilities costs are lower. Lower rated notes become progressively more expensive for the structure as they pay higher spreads to investors. Hence, if the structure is not able to at least issue the same amount of triple-A notes, the cost of funding is expected to increase. This reasoning is, however, not 100% air tight precisely for the fact that the costs indeed increase progressively. The above reasoning implicitly assumes that if the structure is not able to meet the BDR at triple-A level, it is very likely to fail at lower rated notes as well. However, if the structure would be able to meet the BDRs on the lower levels, it would be able to issue more notes at this lower levels and thereby reduce the amount of notes issued at the even lower levels. As such it might actually improve the ROE by decreasing the size of the equity, rather than by lowering the weighted average costs of the rated liabilities.
Therefore structure 5 was exposed to an additional scenario run, including all the scenarios for the double-A rated notes. This additional test showed that structure test was not able to meet the double-A SDR of 48.492%, reaching a BDR of 45.543%. As such it is safe to say that none of the structures is able to achieve an improved ROE given the current conditions.

6.3.3. Analysing the simulations

Even though the test-structures fail to meet the BDR levels, analysis of the results does provide some interesting insights with regards to the test-structures behaviour under different stress scenarios. At first glance it appears that the structures which use a super senior VFN are less resilient against interest rate movements than structures in which the VFN ranks pari-passu with the senior notes. In some instances this difference is rather large, a BDR of 46.1% for a structure using a senior ranked VFN, a like for like payment allocation and redenomination compared to 57.6% for a structure using a pari-passu ranking VFN, a like for like payment allocation and redenomination, while in others this difference is rather minimal and even reversed, a BDR of 38.9% for a the SPN test-structure compared to 38.7% SPY test-structure.
Furthermore, it seems that the choice for a like-for-like structures greatly impacts the structure‘s resilience against moves in the interest rates, while the impact of allowing the VFN to redenominate the liabilities from Sterling into euro appears to be very limited.
The interesting aspect is, however, not so much that these structures differ, but how these differences can be explained. Therefore the next section will summarise the main

conclusions of the pair-wise comparison made between the structures in appendix A.11. A pair-wise comparison between structures with just one different feature allows for gauging of the effects of that particular structural feature on the test-structures performance.

The ranking of the VFN

The pair-wise comparison between the structures differing with regards to the ranking of the VFN shows that the position of the VFN in the waterfall significantly influences the amount of defaults a structure is able to sustain. According to appendix A.11 a structure including a senior ranked VFN can sustain on average 6% less defaults than a comparable structure in which the VFN ranks pari-passu. Interestingly, this difference is strongly related to the application of funds in the structure, be it on a like-for-like or pro-rata basis. It appears that a senior ranking VFN increases the BDR of a structure using a pro-rata cash allocation, while it decreases the BDR when a like-for-like cash allocation is used. In other words using a like-for-like cash allocation in a structure with a senior ranking VFN changes the slight gains caused by its higher ranking in to a significant reduction of the achievable BDR of the AAA term notes.

The analysis in the appendix shows that these different results are mostly related to the slope of the Euribor and Libor curves; where the structures including a senior VFN and a like-for-like payment allocation clearly benefit from a downwards sloping or forward Euribor index and an upwards moving Libor index. Furthermore it was found that the performance of these structures declines in an environment with an appreciating pound sterling.

The allocation of funds

Based on the analysis in the appendix it appears that the difference between a structure using a like-for-like payment allocation and one which uses a pro-rata payment allocation is ambiguous. The histograms show two distinctive peaks. Around the left peak a cluster of scenarios is formed for which the pro-rata allocation outperforms the like-for-like allocation, while this is reversed at the right peak. These peaks are a consequence of the different sensitivities of the structures to different rating parameters. For one set of parameters a like-for-like payment allocation clearly outperforms a pro-rata allocation, for example for a forward or downwards sloping Libor index and an appreciating Sterling. In contrast, a structure using a pro-rata payment allocation has a higher BDR when an upwards sloping Libor index is applied and the value of the Pound remains stable or depreciates.

The ability to redenominate

With regards to the ability to redenominate the VFN it can be concluded that this feature is on average beneficial to a structure. Without exception the structures which allowed to redenominate achieve a higher average BDR level than the structures which didn't have this feature. Nevertheless, the histograms show that the ability to redenominate is not beneficial for each and every scenario. Apparently the option to redenominate does increase the structures sensitivity with regards to some of the stress parameters. This sensitivity is best observed in the tables governing the Euribor and Libor index, where an upwards slope of either index appears to be more stressful to a redenominating structure.

Interestingly, the reverse of this observation appears to be true when both the indices move in parallel.

Conclusion

The analysis above provides interesting insights in the behaviour of the different structures under different stress scenarios. Through this analysis it is learnt that each structural feature is subjected to its distinct sensitivities, but also that when the right structural features are combined, the BDR can be significantly increased. This is easily observed in tables included in appendix A.11 which shows that a PLY structure is able to sustain a much higher default rate than a PNN structure.

But despite their potential it can be concluded that none of these structures are able to meet the desired BDRs in the stress test and no combination consisting of only these structural features will be able to do so. As such the choice for a structure only including these structural features presents a trade-off between a higher return on equity in the NWIII or increased flexibility for the CM in the test-structures.

6.3.4. Using principle to cure the asset-liability mismatch

Even though the previously discussed seem not be able to attain the desired BDR this does not mean that a VFN cannot be an improvement over the existing foreign exchange risk hedges in terms of equity returns. After consultation with NIBC, it was decided that one additional attempt would be made to check whether the BDR of the test structures could be improved to the required levels. This improvement should comply with two conditions: 1) the feature implemented in the structure should directly confront the problem at hand, and 2) the solution should already exist in the CLO market.

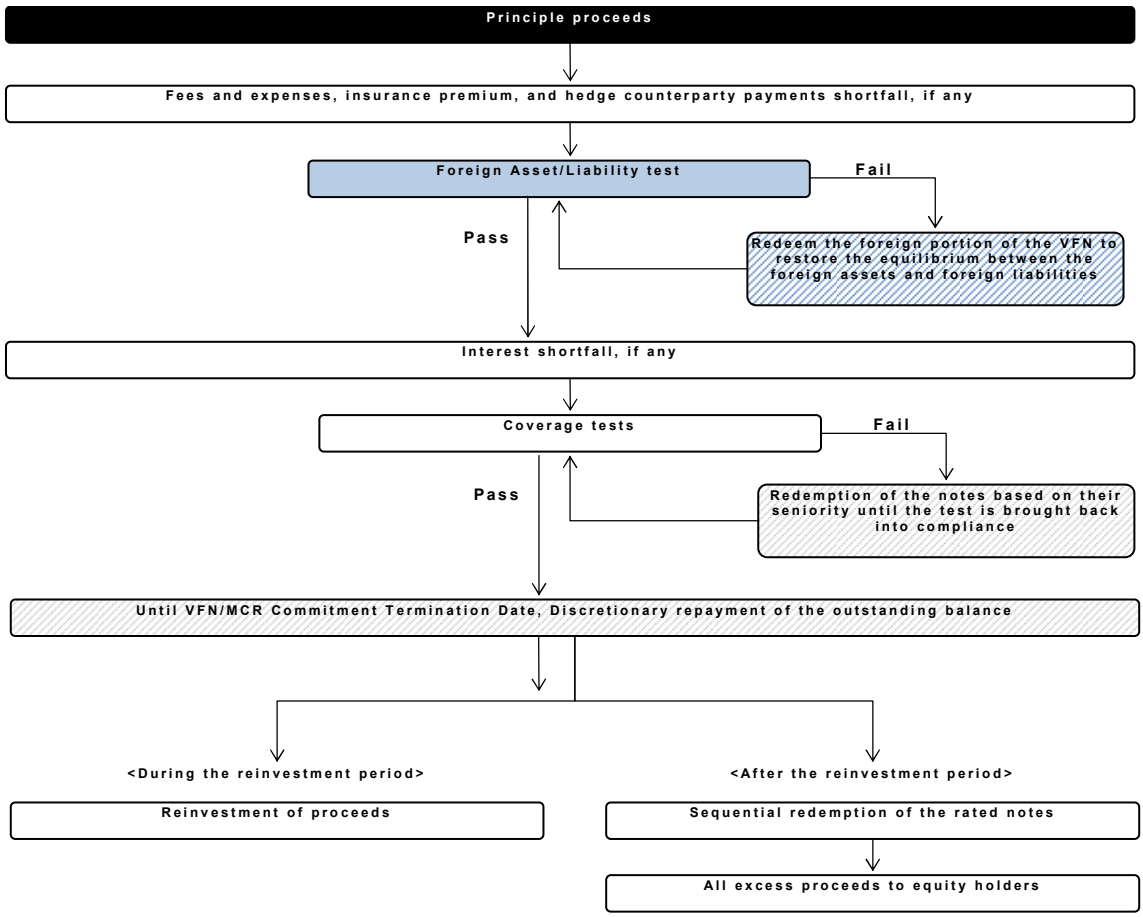
The first condition was included because it seemed that the lower BDRs of the test structures were driven by the high level of stress caused by the asset liability mismatch resulting from biasing the defaults rate towards the GBP assets. Therefore any potential improvement for the test-structures should be aimed at reducing the consequences of this mismatch. This second condition was agreed upon in order to ensure that the resulting test-structure could at least have been sold in the CLO market between 2006 and 2007. Thereby providing the implicit assurance that at one point both investors and the rating agencies felt comfortable with the chosen solution. As a consequence of the second condition the alternative of extending the redenomination period beyond the reinvestment period was eliminated.[28]

A promising solution was found by going back to the study of the existing CLO structures traded in the market performed as a part of this research. This study revealed that some of the CLO structures included covenants stipulating a maximum mismatch between the

[28] Nevertheless, a test run was performed to explore whether modifying this feature could improve the BDR up to the required value. The results of test run, which allowed redenomination throughout the life time of the transaction instead of just during the reinvestment period, indeed confirm that this would have been a potential solution.

assets and liabilities. These covenants either force the Collateral Manager to redirect principle proceeds destined for the senior notes to cure for the asset liability mismatch, for example by prioritising reinvestments in foreign denominated assets or by accelerating the redemptions of foreign notes. In some transactions these clause even went as far as to demand that the Collateral Manager traded assets to bring the asset liability mismatch back into compliance. An example of such a clause is for example found in the indenture of the Marquette US/European CLO. This covenant restricts the asset liability mismatch in any of the eligible currencies to a maximum of 5%, before requiring the collateral manager to take action (offering circular Marquette US/European CLO, 2006). To reduce the sensitivity of the test structures a slightly adopted version of this feature was included in the cash flow models; whenever defaults among the foreign assets resulted in a mismatch between the foreign assets and foreign liabilities principle would be redirected from the senior ranked notes for curing this problem. In the cash flow model this basically meant that principle proceeds were used to redeem GBP liabilities in order to restore the balance between the assets and the liabilities, figure 6.2.

Figure 6-2: Priority of payments including the prioritisation rule



Rerunning the S&P rating scenarios on the cash flow models representing the test-structures and including this additional feature lead to the following results, Table 6.4:[29]

Table 6-4: Test results after including the prioritisation rule (20% worse scenarios)

Cure mismatch A/L									
Structures									
		Ranking VFN	Structure type	Redenomination	Scenario Default Rate	>= Base Case	Options		
	Spread in BP	Senior/ Pari-passu	Like-for-like/Pro-rata	Yes/No	Percentile BDR (0,05)	Pass/Fail	Strike price	Amount	Cost
Base case structure		n/a	Pro-rata	n/a	60,00%	n/a	n/a	n/a	n/a
structure 1	284	Senior	Like-for-like	Yes	61,20%	Pass	€ 2,01	32.750.000	€ 8.094,473
structure 2	284	Senior	Like-for-like	No	59,32%	Fail			
structure 3	284	Senior	Pro-rata	Yes	61,01%	Pass	€ 1,99	29.000.000	€ 2.179,77
structure 4	284	Senior	Pro-rata	No	59,68%	Fail			
structure 5	284	Pari-passu	Like-for-like	Yes	61,76%	Fail[1]			
structure 6	284	Pari-passu	Like-for-like	No	60,99%	Fail[2]			
structure 7	284	Pari-passu	Pro-rata	Yes	62,45%	Pass	€ 2,23	32.500.000	€ 1.133,738
structure 8	284	Pari-passu	Pro-rata	No	62,05%	Pass	€ 1,70	27.500.000	€ 104.316

From these results it becomes immediately apparent that requiring principle proceeds to be used to address the asset liability mismatch senior to the redemption of the rated notes results in a staggeringly improved BDR. Out of the 8 test structures 6 were able to achieve the desired value for the BDR in the stress tests performed on the initial 20% most stressful scenarios. Unfortunately follow up tests concluded that 2 out of these 6 test-structures did not pass when all the stress scenarios were run. These 2 structures, structure 5 and 6 were therefore disregarded.

When the effects of using principle to cure the asset liability mismatch are considered, it appears that the increase in the BDR of the test structures differs widely from one structure to another, table 6-5.

[2] These structures were disregarded as subsequent test proved that they unfortunately did not make the SDR in all situations.

Table 6-5: Comparison between the BDRs achieved in the two tests

Structures	Cure mismatch A/L	original	difference
structure 1	61,20%	46,01%	15,19%
structure 2	59,32%	45,51%	13,81%
structure 3	61,01%	39,28%	21,73%
structure 4	59,68%	38,90%	20,78%
structure 5	61,76%	57,62%	4,14%
structure 6	60,99%	55,48%	5,51%
structure 7	62,45%	39,08%	23,37%
structure 8	62,05%	38,70%	23,35%

It seems that curing the asset liability mismatch offsets the benefits obtained by using a senior ranked VFN. As a matter of fact, the structures using a VFN ranking pari-passu with the senior notes outperform their direct peers with a senior ranking VFN. Simultaneously, the benefits of a like-for-like payment feature relative to the pro-rata allocation of payments became negligible. In structures which do not cure the asset liability mismatches, the like-for-like principal allocation feature gives a benefit of 6% to 18% in the BDRs relative to the structures with pro-rata principal allocation. By introducing the asset liability mismatch test, this benefit is reduced to mere hundreds of a percent or even reversed. Interestingly, the ability to redenominate remains beneficial. All the structures that allow to redenominate the VFN are able to sustain a higher BDR than their peer structures which do not use this feature.

6.4. Optimising the hedges

From table 6.4 it can be observed that the BDR levels of these structures are somewhat higher than the SDRs covenanted for NWIII. This means that the level of risk assumed by the triple-A tranches in the test structures is lower than the risk assumed by the same tranche in NWIII. In order to decrease the BDRs of the triple-A notes of the test-structures and increase their risk levels to the level which was assumed by the triple-A notes issued by NWIII, part of the FX-risk initially mitigated was allowed back into the structures such that the relevant BDRs decrease. Analogous to the methodology set out in the first section of this chapter, this was done by firstly increasing the strike price of the currency options and secondly by reducing the number of available options in each of the structures.

For the four remaining structures the minimum required strike price was determined by running the strike price runner. This model iteratively increased the strike price in the cash flow model until the structure was no longer able to meet the required SDR given the parameters specified by the rating scenario. From the resulting data set the 5^{th} percentile was calculated in order to find the minimum strike price required.

The resulting strike prices were used as input in the option runner to determine the minimum amount of options the structures required to just make the SDR. A final simulation was run on all the triple-A scenario to confirm that indeed the calculated numbers provide an optimal hedging solution. Lastly the costs related to the hedge were approximated using a modified version of the Cox, Ross and Rubinstein binominal

approach for valuating American style options. The results of this process were already included in table 6.4.

6.5. Optimising the tranching

Thus far the tests performed on the structure have concentrated on the most senior level, here the triple-A notes. The first tests were aimed at ensuring that the test-structures are able to at least meet the similar risk level as the NWIII at the most senior level. In the second test the optimal option strategy was determined in order to reduce the upfront cost incurred by the structure.

According to the methodology described in section 6.2.3 of this chapter, the next step in optimising the cost structure of the test-structures constitutes an attempt to improve the structure's tranching. Unlike the triple-A notes, the BDR achieved by these tranches could not be improved by included additional options or lowering the strike price. Such an adjustment would have negated the efforts put into optimising the structure in the first step. As an alternative, the subordination of the notes was adjusted. Increasing the subordination reduces the risk assumed by the note and therefore increases the BDR. Contrarily; by decreasing the subordination the risk assumed by the notes increases and the BDR decreases.

After the methodology was applied to each of the structures the resulting tranching per test-structures looked at follows:

Notes	**Structure 1: SLY** Amount Issued (EUR equiv.)	**Structure 2: SPY** Amount Issued (EUR equiv.)	**Structure 3: PNY** Amount Issued (EUR equiv.)	**Structure 4: PNN** Amount Issued (EUR equiv.)
VFN/MCF Funded in Euro	80,000,000	80,000,000	80.000.000	80.000.000
VFN/MCF Funded in GBP	60,000,000	60,000,000	60.000.000	60.000.000
Class A1 notes	150,000,000	150,000,000	150.000.000	150.000.000
Class B1 notes	35,000,000	35,000,000	34.500.000	35.000.000
Class C1 notes	18,000,000	17,000,000	19.000.000	21.000.000
Class D1 notes	13,500,000	15,000,000	15.000.000	18.500.000
Class E1 notes	17,000,000	13,000,000	16.500.000	8.500.000
Equity	36,353,461	39,801,147	34,802,203	36.905.476
Total	**409,853,461**	**409,801,147**	**409,802,203**	**409,905,476**
Average spread	**50 bp**	**50 bp**	**46 bp**	**43 bp**

From the table above it can be seen that each of the structures has a different optimal tranching. Consequently, each of the structures has a different weighted average spread and a different size of the equity piece. Interestingly, while the size of most tranches seems specific to each structure, the size of the B notes can be roughly increased by 3 million compared to the NWIII regardless of the structural features used (2.5 million for the SPY structure and 3 million for the 3 other structures).

The weighted average spread on the liabilities of the test-structures is lower than the weighted average spread paid in the NWIII; 53 bps for the NWIII compared to 50, 50, 46 and 43 bps for the SLY, SPY, PPY and PPN structures respectively. Simultaneously the

size of the equity piece has increased for all but one structure compared to the NWIII. Where the equity piece in the NWIII was 36.3 million, the equity piece in the test-structures were (in millions) 36.35 – SPY, 34.85 – SPY, 39.85 – PPY and 36.85 – PPN. These two observations are expected to have a large, albeit contrasting, impact on the return on equity. The lower the weighted average spread, the more money should remain for the equity holders, increasing the ROE. In contrast, by increasing the amount of equity the residual proceeds have to be distributed over more equity, lowering the average return. By running the equity scenarios it was determined which of these two changes played a more significant role and whether there were other factors with an even greater influence on the return on equity. The structures were compared against each other with respect to the magnitude of the ROE.

6.6. Calculating the ROE

The results of running the equity scenarios on the optimised structures are depictured in the figure 6-3 and table 6-2 below. The figure displays the ROE the structures was able to deliver when a 75% recovery rate was assumed and the default rate was steadily increased from an annual rate of 0% up to a maximum rate of 8% per annum. It goes without saying that the maximum cumulative default rate in each scenario was 100% and that a higher default percentage therefore shortened the average life of the assets.

Figure 6-3: ROE of the structures under different default assumptions

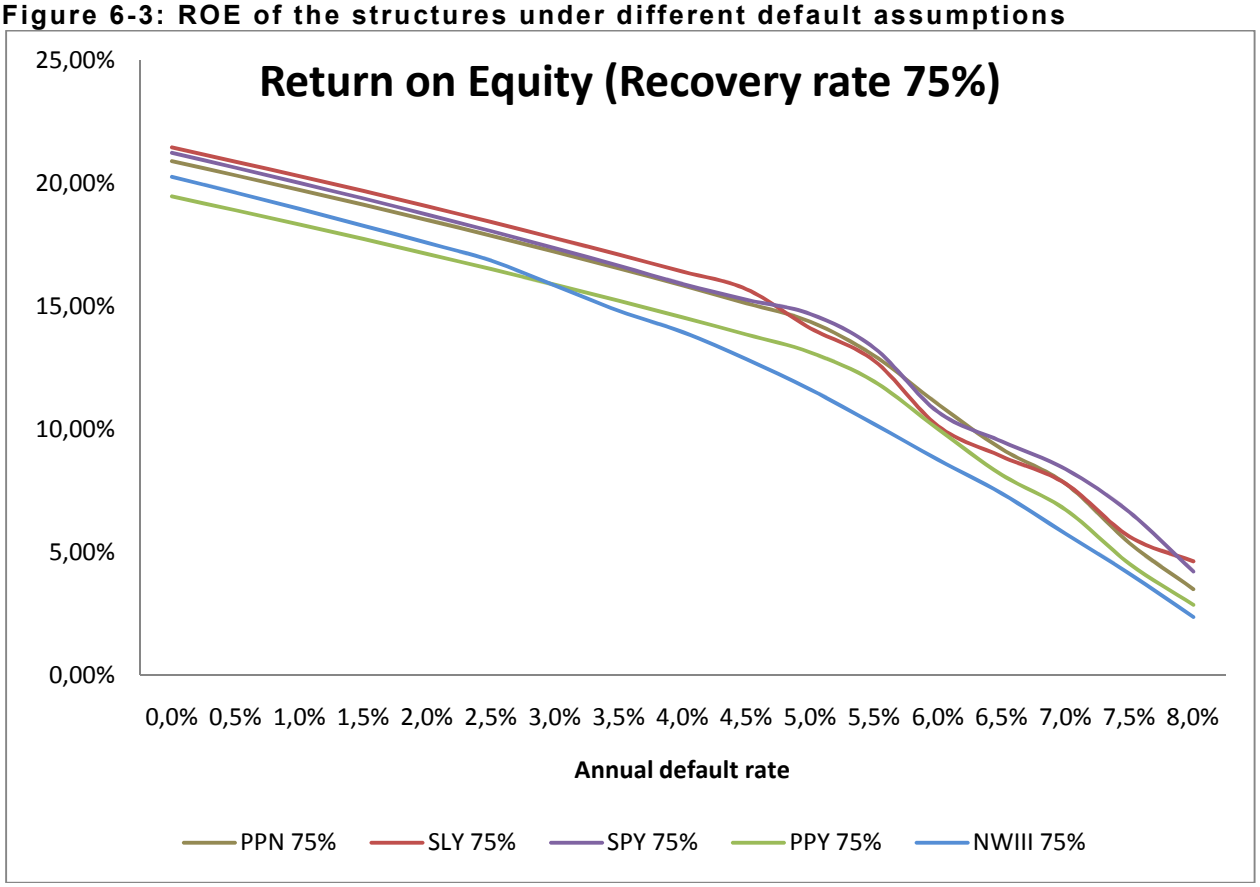


Table 6-6: Return on equity of the different structures under different default assumptions

Annual default rate (75% recovery rate)									
Structure	0,0%	1,0%	2,0%	3,0%	4,0%	5,0%	6,0%	7,0%	8,0%
NWIII	20.26%	18.95%	17.58%	15.84%	13.95%	11.62%	8.76%	5.74%	2.36%
SLY	21.45%	20.28%	19.05%	17.76%	16.40%	14.10%	10.13%	7.78%	4.63%
SPY	21.24%	20.01%	18.73%	17.36%	15.91%	14.69%	10.70%	8.38%	4.21%
PPY	19.47%	18.33%	17.13%	15.88%	14.55%	13.13%	10.00%	6.73%	2.86%
PPN	20.89%	19.72%	18.50%	17.20%	15.84%	14.36%	11.01%	7.77%	3.49%

The output of the equity scenarios shows that almost all the final test-structures were able to achieve higher ROE than the NWIII at all annual default rates assumed. This suggests that the benefits obtained by a reduction of the weighted average spread paid on the liabilities and an increased spread received on the assets outweigh the burden of an increased equity tranche. The notable exception being the PPY structure which achieved a lower ROE when the default rate was low due to the structure's considerably larger equity requirements. Whilst the structure was able to outperform the NWIII when the annual default rate surpassed 3,0% annually, the ROE of the PPY structure was considerably lower than the ROE obtained by the other structures.

Out of the three other test-structures, the SLY and SPY structures were able to achieve a higher ROE than the PPN structure when the default rate was below 5,0% or above 7,0% per annum. The lower ROE obtained in this range of default rates was a consequence of the failure of multiple OC-tests by the SLY and SPY structures which trigged an early redemption of the senior rated note and consequently reduced the amount of interest proceeds available for the equity note holders.[30] The initial order in ROE levels was restored after the default rate surpassed the level of 7% per annum as the speed of the redemption of the notes started to keep a more equal pace between the three structures.

Finally it should be concluded that out of the two test-structures the SLY structure showed the most promising results. Not only does the SLY outperform the SPY structure for 6 of the 9 measured default rates and had the highest average ROE, but it also achieved the highest ROE when the anticipated annual default rate of 2% is used.

30 A general principle governing structured financial products states that in general the rated note holders benefit from a quicker return of principle and therefore favour redemptions over reinvestments. In contrast the interest of the equity provider is usually better served by a reinvesting unscheduled principle such that the average life of the transaction is increased and a fresh stream of interest is generated.

6.6.1. Stress testing the results of the equity scenarios

To further analyse the output of the equity scenarios a number of tables and figures are presented in appendix A.12. These tables and figures were used to analyse the sensitivities of the ROE of the test-structures with regards to a change in the recovery rates, a parallel shift of -1% and 1% in the EURIBOR or LIBOR index and a parallel shift of -10% and 10% in the FX curve.

These figures suggest that regardless of the recovery rate the test-structures were able to perform at least as good as, but usually better than the NWIII (A.12 figure 4, 8 and 12). Furthermore, the relative performance of the structures remained mostly unchanged; the structures including a senior rated VFN still outperform the structures using a pari-passu ranking VFN. However, a comparison between tables 2 and table 4 shows that independent of the direction of the change in the recovery rate, the SPY structure outperformed the SLY structure when the default rate surpassed the level of 5% per annum.

A similar result was found by comparing the performance of the test-structures to the performance of the NWIII when the EURIBOR or LIBOR rate was increased or decreased with 1%. Again the test-structures clearly outperformed the NWIII while their relative performance remained largely unchanged. The most notable exception being the change in relative performance between the SLY and SPY when EURIBOR was increased with 1% or LIBOR was decreased by 1% and the annual default rate reached 8%.

Interestingly the ROE of the test-structures and the NWIII show a contrasting response to a change in the EURIBOR rates. Whilst the test-structures achieved an increased ROE when the EURIBOR rate was decreased, the ROE of the NWIII decreased when the EURIBOR rate was decreased. The contrasting response to a change in the EURIBOR rate is a consequence of the duo currency structure employed in the test-structures. By increasing EURIBOR relative to LIBOR it becomes more difficult to fulfil the Euro denominated liabilities with the excess proceeds of the GBP denominated assets.[31]

Corollary, the performance of the structures improved when the LIBOR rate was increased and worsened when the LIBOR rate was reduced.

Lastly the performance of the structures was observed when the FX-rate was increased and decreased by 10%. Appendix A.12 shows that the test-structures' performance improved when the FX-rate decreased as less funds had to be used to purchase the foreign assets at the transaction's inception and covering the expected losses became cheaper.

There is one notable exception to the above: when the annual default rate approached 6,0% the test-structures perform better when the FX-rate is increased instead of decreased. This 6,0% level appeared to be a critical value. Below an annual default rate

31 The test-structures receive LIBOR + Spread on the GBP assets and pay LIBOR + spread on the liabilities. Due to the different rating on the assets (low) and liabilities (high) the structures receive more pound sterling than they have to pay. This difference should first be used to fulfil the Euro denominated liabilities and ultimately to pay the equity note holders. When the EURIBOR rate increases fulfilling the Euro liabilities with the GBP proceeds become increasingly expensive. Consequently the funds remaining for the equity note holders decreases.

of close to 6,0% the test-structures reach their final maturity without failing any of the OC or IC tests. In contrast, when the annual default rate reaches 6,0% the structures start failing coverage tests. This in turn triggers early redemption of the notes, thereby reducing the average life time of the transaction and the amount of interest proceeds available for the equity note holders.
The default rate at which the first coverage test failure occurs has a significant impact on the ROE. This value differs from one structure to another and is responsible for the sudden jumps visible in the ROE as well as for the change in the relative performance of the test-structures.

6.7. Conclusion

Based on the results obtained by running the equity scenario it can be concluded that the structural features used in the test-structure have a significant and positive effect on the ROE. Even when the recovery rates, EURIBOR index, LIBOR index or FX-index are altered, the test-structures are able to outperform the NWIII.
Out of the remaining 4 test-structures the SLY structure was able to achieve the highest ROE, slightly outperforming the SPY structure. The structures using a pari-passu ranking VFN were not able to match the ROE of their peers using a senior ranking VFN. While the ROE of PPN structure remained reasonably close to the SPY structure, the PPY structure performed considerably less favourable and sometimes struggled to outperform the NWIII.

7. Discussion

7.1. Introduction

In the previous section it was shown that none of the original test-structures were able to meet the required SDR levels as the interest and foreign exchange risks introduced into the structure by removing the PAS proved to be too severe for the proposed hedging solutions. This came as somewhat of a surprise as some of the test-structures closely resembled transactions sold and traded in the market. Obviously, the possibility exists that the issuer and investors in this transaction opted higher flexibility offered by these types of transactions and took the slightly reduced returns for granted. More likely these transactions were modelled on a slightly different basis or included certain clauses which were not publicly disclosed, but did improve their ROE to an acceptable level. Any further discussion on the differences or similarities between the transactions would be utterly speculative as it is impossible to draw any well grounded conclusions without fully replicating the modelling exercise performed to create these products and compare the end results.

Therefore this section will first focus on the consequences of including the various structural features in a CLO's structure and discuss how the structural features influenced the CLOs performance. Secondly, it will discuss why the relatively minor change of prioritising the use of principle to maintain the equilibrium between the foreign assets and liabilities had such a profound impact on the performance of the test-structures.

7.2. The consequences of including the structural features

Replacing the PAS with a VFN in the original NWIII structure meant that the structures were no longer perfectly hedged against movements in the foreign interest index and foreign exchange rate. As defaults occurring during the life of the transaction disrupted the fragile equilibrium existing between the foreign assets and liabilities, the proceeds obtained from foreign assets were no longer sufficient to pay for the foreign liabilities. Consequently proceeds obtained in the domestic currency and based on the domestic interest rate had to be exchanged into the foreign currency in an amount sufficient to meet the foreign liabilities based on the foreign interest rate, thereby exposing the transaction to movements in the foreign interest index and the FX rate.

To reduce these risks three structural features were included in the test-structures: the ranking of the VFN, the distribution of the proceeds and the ability to redenominate. Basically these structural features focus on restoring the equilibrium and/or preventing a mismatch from occurring.

In section 6.3.2 it was shown that the structures which included the VFN on a senior level achieved a higher BDR than structures ranking the VFN pari-passu with the senior notes, except when the structure also included a like-for-like payment allocation. In addition, the ability to redenominate seemed to have had a positive influence on the test-structure resilience.

These results are a logical consequence of the inclusion of these structural features. The quicker the amount of foreign assets is reduced, the more favourable this should be for the structures ability to pay its liabilities, as the potential risks related to interest rate mismatched and fluctuations in the FX-rate are reduced. By ranking the VFN senior the priority of payments automatically directs any principle destined for redemption towards the VFN instead of the VFN and the class A-notes concurrently. As such the GBP liabilities were redeemed quicker in a structure with a senior ranking VFN than in a comparable structure with a pari-passu ranking VFN. Confirming the results observed in section 6.3.2.

The amount of fund available for the redemption of the foreign liabilities is further influenced by the allocation scheme applied in the structure. Applying a like-for-like payment allocation in a CLO structure will ensure that the proceeds in the foreign currency will first be applied towards the liabilities in that respective currency. In contrast a pro-rata structure allocates funds based on the weighted average size of the pari-passu ranking notes. Which of these allocations schemes is most beneficial to the structure depends on the amount of foreign liabilities, the default bias and the ranking of the VFN.

The monetary amount of defaults occurring in the pool of foreign assets is dictated by the S&P formula used to bias the default rate. Given that 15% of the assets used in the NWIII CLO were denominated in a foreign currency, 26.1% of the monetary equivalent of the total amount of defaults should occur in the pool of foreign assets. This means that when a like-for-like payment allocation is applied in the structure, 26.1% of the recoveries will be used to redeem the foreign liabilities independent of the ranking of the VFN.
In comparison, under a pro-rata scheme this percentage would equal 60 million / 140 million= 42.9% when the VFN ranks senior and 60 million / 290 million = 20.7% when the VFN is ranking pari-passu. On these grounds the NWIII structure should benefit from a like-for-like payment allocation when a pari-passu ranking VFN is included, while a pro-rata payment allocation should be preferred when the VFN is included on a senior level. The prior is confirmed by the results presented in section 6.3.2, while the latter seems to conflict with these findings as test-structures 1&2 outperform test-structures 3&4.

Up to now the focus of this discussion has been on the ability to redeem the foreign liabilities as the manner to restore the equilibrium between the foreign assets and liabilities. However, during the reinvestment period this equilibrium is largely maintained through the reinvestment of recovery proceeds and eventually part of the residual interest proceeds. The manner in which these proceeds are reinvested depends on the payment allocation used in the structure. Under a like-for-like payment allocation the interest proceeds obtained from the foreign assets will first be used to fulfil the liabilities in the respective currency. As the foreign liabilities are senior and highly rated, the total interest proceeds are usually more than sufficient to fulfil these liabilities, providing that Euribor and Libor stay reasonably similar. The remaining proceeds will only be used to fulfil the liabilities denominated in the base currency in so far the interest proceeds obtained in the base currency are insufficient to meet the related liabilities. Consequently, most of the proceeds remaining for reinvestment will consist of foreign

funds which will first be used for reinvestments in foreign assets and hence help to reinstate the equilibrium between the foreign assets and liabilities.
When a pro-rata payment allocation is applied the amount of proceeds available for reinvestment will be reinvested on a pro-rata basis (e.g. based on the weighted averages), which might mean that even when most of these proceeds consist of foreign funds, less funds are reinvested in foreign assets. In this instance the probability that the equilibrium is restored is lower than under a like-for-like allocation scheme, increasing the risk assumed by the structure and lowering its BDR. While it is uncertain to what extent these different reinvestment allocations contributed to the increase in the BDR, they explain the seemingly contradictory results presented in section 6.3.2.

As a final structural feature the ability to redenominate the liabilities under the VFN was introduced. The analysis performed in the appendix A.11 proved that this ability was favourable in each structure regardless of the other structural features used. Even though the benefits were only marginal. This should come as no surprise as the ability to redenominate provides an easy and quick way to restore the equilibrium between the foreign assets and liabilities. The observation that the structures only marginally benefitted from this structural feature is mainly due to the fact that redenominating was only allowed during the reinvestment period; the first 6 years of the transaction. As such the ability to redenominate could only be used on the usually less stressful scenarios.

7.3. Consequences of prioritising the use of principle to cure the asset-liability mismatch

Even though each of these structural features held much potential for reducing the stress introduced into the structure by removing the PAS, no combination of these structural features proved to be sufficient to achieve the SDR. To alleviate some of the stress caused by the FX and interest rate risk, the decision was made to prioritise the use of principle to cure any eventual mismatch between the foreign assets and liabilities. This prioritisation rule basically meant that principle would first be used to redeem the foreign liabilities in an amount equal to the defaults before any principle would be used to redeem any of the domestic liabilities. In so doing the average life of the foreign assets was reduced and any disruption of the equilibrium between the foreign assets and liabilities was cured in an early stage. In line with expectations this had a significant and positive effect on the BDR of the test-structures, even though the domestic notes were disadvantaged.

More interesting however, is the effect that this rule had on the performance of the 8 test-structures. The results clearly showed that prioritising the use of principle to cure the foreign assets and liability mismatch complemented the effects of redenominating. The ability to redenominate partially filled the gap between the moment principle proceeds became available, up on recovery, and the moment the actual default occurred. Subsequently each structure which was allowed to redenominate was able to achieve a higher BDR than its peer. The fact that one of the structures which allowed to

redenominate had to be disregarded after failing the SDR-test does nothing to invalidate this conclusion as the same thing happened to its direct peer.

The benefits provided by ranking the VFN senior were significantly reduced by prioritising the use of principle to restore of the equilibrium. In the original set up ranking the VFN senior meant that the foreign liabilities would be redeemed at a higher pace, which reduced the chances that the foreign liabilities would be significantly larger than the foreign assets. Naturally the enhanced speed of the redemption could also turn into a destabilising factor when the foreign liabilities were redeemed at a higher pace than the default rate. While this was not a big concern in the original situation, this distortion could significantly grow under the newly introduced rule. After using any available interest proceeds to redeem the foreign liabilities in an amount equal to the foreign deficit, i.e. the difference between the foreign assets and liabilities, any remaining proceeds would either be used for reinvestments or for the redemption of the senior ranking notes. These reinvestments or redemptions would distort the newly restored equilibrium between the assets and the liabilities and therefore re-introduce FX and interest rate risk, albeit in the reversed direction. This distorting effect is best illustrated using an example, box 6.

Box 6 example

Consider a CLO structure which includes a senior ranking VFN with the size of 20, consisting of two equally sized parts with a value in base currency equivalent of 10. One denominated in the domestic currency and one in a foreign currency. The structure has a base currency equivalent of 10 ready for the redemption of its senior notes. These 10 will be allocated to the notes based on a pro-rata allocation scheme. Further consider that due to a sizeable default in the foreign assets, the foreign assets have been reduced to 6, leaving the structure with a foreign deficit of 4.

In the original situation each of the notes would receive 5, regardless of any foreign deficit.

In contrast, by implementing the new rule, the proceeds of 10 would first be used to restore the foreign deficit of 4. The remaining 6 would thereafter be allocated to both components of the VFN on a pro-rata basis. This would result in a reduction of the domestic part of remaining proceeds * Domestic liabilities / total equally ranked liabilities = 6 * 10 / 16 =3.9 and a reduction in the foreign part of 2.1 + 4 = 6.1. A difference of more than 20% compared to the original situation.

This example clearly illustrates that the implementation of the new rule can result in vastly different result, which could potentially offset the freshly restored equilibrium.

Similarly, the initial benefits from applying a like-for-like payment allocation scheme in a structure using a pro-rata ranking VFN turned into a hindrance after the prioritisation rule was introduced.

Above it was already shown why applying a like-for-like allocation scheme was beneficial to a structure which uses pari-passu ranking VFN. Due to the default bias the recoveries in the foreign currency were higher than expected on a pro-rata basis. By applying a like-

for-like allocation scheme all these higher proceeds would be used for the redemption of foreign liabilities or reinvestment in foreign assets instead of just the pro-rata amount.
The manner in which the prioritisation rule was implemented in the cash flow model ensure that first the foreign proceeds would be applied to restore the equilibrium before any domestic proceeds would be used to fill the remaining gap. As such the danger of overshooting the redemption of the foreign liabilities by means of the proceeds was negated by applying a like-for-like structure.
In contrast this risk was severely strengthened with regards to interest proceeds. Upon a failure of either the OC or IC test interest proceeds would be used to redeem the senior ranked notes. Much of these interest proceeds usually consisted of foreign interest proceeds when a like-for-like structure was applied. These foreign interest proceeds would consequently be used to redeem the foreign liabilities, distorting the balance between the assets and liabilities and introducing interest and FX risk.

7.4. The final results

Naturally, the severity and consequences of introducing these risks depend on the assumptions made with regards to the trajectory followed by the interest indices, FX index and the default rate, timing and pattern. This is clearly shown by the ROE the four remaining test structures were able to obtain and their comparative achievements. The structures which based on the argumentation in this discussion should have shown the worst results were the actually clear winners. The fact that a senior ranking of the VFN and a like-for-like payment allocation were beneficial in this situation was mainly due to the shape of the FX curve and the significantly higher LIBOR base rate.
The FX-curve slowly declined during the first 5 years of the life of the transaction, reducing the amount of money required to redeem the foreign liabilities. This decline flattened after the first 5 years and the FX-rate remained stable for the next 4 years. Subsequently the trend in the FX-index reversed and after year 9 started to return to the initial levels. The shape of the FX-index was beneficial to those structures which still maintained a relatively large portion of foreign assets without the relating liabilities. This was mainly the case for the SLY and SPY structures.
In addition, throughout the life time of the structure, the LIBOR base rate is significantly higher than the comparable EURIBOR rate. Consequently, overcollateralisation in foreign assets contributed to higher interest proceeds and strengthened the structures performance.
These two factors explain why the results presented in section 6.4, deviate from the expectations. This does not mean that these results are wrong or misleading. The equity scenarios are based on the implied market expectations and they show the expected performance of the structures based on these market rates. Nevertheless it should be pointed out how sensitive the results are to changes in assumptions and that blind trust in these assumptions can be dangerous.

8. Conclusion & recommendations

8.1. Conclusion

To increase the diversity of the collateral portfolio, or to ensure that sufficient investment opportunities in a specific class of asset are available, asset managers are often motivated to include assets from various domiciles. This diversification technique reduces the idiosyncratic risk in the asset portfolio by reducing the number of factors the different assets have in common. But while geographic spread reduces the dependency on a specific country or economic region, it introduces the CDO investors to the additional risk that results from uncertainties with respect to future foreign exchange and interest rates.

This research project set out to identify the methodologies used by CDOs currently traded in the market to hedge themselves against these two types of risk. In addition the consequences of these hedging strategies on the capital structure of a CDO were investigated. Consequently, the research objectives were formulated as follows:

- *To understand what kinds of multi-currency hedging techniques are currently applied in the market; and*
- *To assess the impact of the hedges used to manage the risk related to the multi-currency revolvers on the capital structure and costs associated with the structure.*

From studying the CDO market it followed that there are two different categories of multi-currency hedging techniques currently applied in the CDO market: swaps and natural hedges. These two categories were further subdivided into the four hedging methodologies described in section 3.3: Asset swaps, portfolio swaps, natural hedges and variable funding notes.

The choice for a specific hedging strategy is mostly a trade off between the effects on the capital structure and the flexibility offered to the collateral manager. Swaps, most commonly perfect assets swaps, provide a transparent and are close to perfect hedge against interest and FX-risk, but come at a relatively high price and significantly impact the structures' flexibility. In addition recent market turmoil and rating downgrades of potential swap counterparties have both limited the availability and increased the price of these instruments.
Naturally hedged transactions, including multi-currency revolvers, provide significantly more flexibility than the (perfect) asset swaps, while still providing much of the sought protection. In addition, the limited costs related to the hedges increase the potential return of the CDO structure.

A thorough analysis of the CLOs rated by S&P between January 2006 and June 2007 indicated that the hedging strategy applied in multi-domestic CLO structures gradually switched from perfect assets swaps to variable funding notes. These naturally hedged transactions subsequently differed in relation to the position of the VFN in the priority of payments of the CLO, the ability to use the VFN to redenominate the liabilities and the way in which the different currencies were used to fulfil the liabilities; like-for-like or pro-

rata. To examine the impact of these three structural features on the capital structure of a CLO, they were implemented in an existing CLO, the North Westerly III, resulting in 8 test-structures.

These 8 test-structures were subsequently stressed using the rating methodology used by S&P to rate multi-domestic CDO structures. This analysis showed that each structural feature is subjected to its distinct sensitivities and that despite their potential none of these structures was able to meet the scenario default rate in the stress test. However, the test results also showed that if the right structural features are combined, the break-even default rate could be significantly increased.

In consultation with NIBC, it was decided that one additional attempt would be made to see whether the BDRs of the test structures could be improved to the required levels. Careful scrutiny of the CLO structures traded in the market resulted in the inclusion of an additional structural feature in the form of a prioritisation rule. This rule ensures that whenever there is a mismatch between foreign assets and liabilities, principle proceeds would be used to redeem the foreign liabilities to restore the equilibrium. Including this rule meant that the amount of FX and interest-rate risks were significantly reduced, which translated into vastly improved BDR levels for the test-structures. Remarkably 4 out of the 8 structures met the SDRs, increasing their BDRs with up to 20%.

After optimising the tranching, the four remaining test-structures were compared based on their return on equity. Given that the risk assumed by all of the rated notes was kept equal, the ROE serves an unambiguous measure of the structures' performance. The results obtained by running the equity scenarios proved that the structural features used in the test-structure have a significant and positive effect on the ROE. Even when the recovery rates, EURIBOR index, LIBOR index or FX-index are altered, the test-structures are able to outperform the NWIII.

Out of the remaining 4 test-structures the SLY structure was able to achieve the highest ROE, slightly outperforming the SPY structure. The structures using a pari-passu ranking VFN were not able to match the ROE of their peers using a senior ranking VFN. While the ROE of PPN structure remained reasonably close to the SPY structure, the PPY structure performed considerably less favourable and sometimes struggled to outperform the NWIII.

In summary, it is concluded that substituting a PAS for a VFN can be beneficial for a CLO structure. This research showed that by choosing either a SLY, SPY or PPN structure, the ROE of the CLO structure can be improved, while at the same time the flexibility offered to the collateral manager is increased.

8.2. Recommendations for further research

Naturally the achieved benefits will depend on the chosen structure and will be significantly affected by the macro-economic environment. It will therefore be interesting to see how these suggested structures perform under the current market conditions instead of the conditions observed in 2006 when the CLO market was still thriving. Even when ignoring the difficulties which the rating agencies have with actually assessing the risks in structured financial products, the high volatility in the foreign exchange markets and the large changes in interest rates will expose the CLO structures to significantly more risk. In addition, the increased probability of default of the assets will have a negative impact on the structures' ability to achieve the required SDR. Furthermore, due to the limited market appetite for structured financial products the offered spreads will have to be considerably increased to attract investors. However, this drawback might be offset by the higher spread received on the assets currently traded in the market and used as collateral in the structure.
These adverse changes in the market conditions present a challenging environment in which a structure including a VFN might thrive or fail. Nevertheless, further scrutiny of the impact of different market conditions on the performance of these hedging techniques should provide valuable insights for future applications.

In addition to researching the effect which the current market conditions will have on the performance of the test-structures, it would be interesting to evaluate the option strategy and valuation methodology applied in this research.
Currently some doubt lingers with regards to the option valuation methodology used in this research. In absence of any real market prices the Cox, Ross and Rubinstein binominal approach for valuating American style options was used to price the currency options. This methodology is one of the standard approaches for valuating American options. However, this methodology appears somewhat inaccurate when it comes to long dated options and not specifically tailored to currency options. Other approaches exist which might provide a better approximation of the price of these options, however, a debate on the various option valuation methodologies lies outside the scope of this research. Nevertheless, applying a different approximation method or using actual quotes from brokers may improve the validity of the results presented in this research.

Another topic for further research could relate to the option strategy applied in the structure. With regard to the use of options, different strategies were observed in the CLO market. Some CLO structures used ingenious strategies wherein options were used with different maturity profiles. These maturity profiles were matched to the expected default pattern of the foreign assets such that the maturity date of the options would coincide with the default of the assets. By shortening the average life of the option portfolio the cost related to this hedging instrument could be reduced. Other structures used a reserve which would be used to purchase short term options at the time of default to lock in the prevailing FX-rate. The maturity of these options would be chosen such that it would match the expected recovery date. The purchase price of these options should be significantly lower than the long dated options used in this research; however, this benefit might be offset by the negative carry on the reserve. Both these option strategies are also

likely to face some serious headwind from the rating agencies due to the increased risk. Therefore it seems likely that the RAs will demand that some stringent conditions are met before assigning a credit rating.

These three research suggestions could provide some additional insight into mechanics of a multi-currency CLO structure including a VFN and should in combination with this research give NIBC an edge when the market for CLOs re-opens. Naturally the achieved benefits will depend on the chosen structure and will be significantly affected by the macro-economic environment. It will therefore be interesting to see how these suggested structures perform under the current market conditions instead of the conditions observed in 2006 when the CLO market was still thriving. Even when ignoring the difficulties which the rating agencies have with actually assessing the risks in structured financial products, the high volatility in the foreign exchange markets and the large changes in interest rates will expose the CLO structures to significantly more risk. In addition, the increased probability of default of the assets will have a negative impact on the structures' ability to achieve the required SDR. Furthermore, due to the limited market appetite for structured financial products the offered spreads will have to be considerably increased to attract investors. However, this drawback might be offset by the higher spread received on the assets currently traded in the market and used as collateral in the structure.
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which would be used to purchase short term options at the time of default to lock in the prevailing FX-rate. The maturity of these options would be chosen such that it would match the expected recovery date. The purchase price of these options should be significantly lower than the long dated options used in this research; however, this benefit might be offset by the negative carry on the reserve and by a potentially higher price of the options later due to increased volatility. Both these option strategies are also likely to face some serious headwind from the rating agencies due to the increased risk. Therefore it seems likely that the RAs will demand that some stringent conditions are met before assigning a credit rating.

These three research suggestions could provide some additional insight into mechanics of a multi-currency CLO structure including a VFN and should in combination with this research give NIBC an edge when the market for CLOs re-opens.

Glossary

Acceleration options	Acceleration option allow costless termination of (part of) the swap contract with exchange of principal. These options are exercised in case of a prepayment or recovery that is not reinvested in the foreign currency.
Arbitrage CDO	A CDO transaction based on assets whose aggregate yield is more than the aggregate yield for which the transaction's securities can be issued.
Asset Backed Security	Bonds or notes backed by pools of financial assets, typically with predictable income flows, originated by banks and other credit providers. Examples of such assets include credit card receivables, trade receivables, and auto loans.
Asset manager	See Collateral Manager.
Asset manager risk	The risk resulting from the dependency on the asset manager to make the right investment decisions.
Asset swap	In a plain vanilla swap, a fixed LIBOR is swapped for a floating LIBOR. In an asset swap, a fixed investment such as a bond with guaranteed coupon payments is being swapped for a floating investment such as an index.
Bankruptcy Remote	The term applied to an entity that is not likely to have an incentive to commence insolvency proceedings voluntarily and that is not likely to have an involuntary insolvency proceeding commenced against it by third-party creditors. Securitisation structures use bankruptcy-remote SPEs to issue notes backed by a pool of assets.
Base Currency	Means, in respect of any revolving obligation or delayed drawdown collateral obligation, the currency in which the commitment under such revolving obligation or delayed drawdown collateral obligation is denominated in accordance with the underlying Instruments thereof.
Basis Point	One-hundredth of one percentage point (i.e., 1 bp equals 0.01%). One basis point is the smallest measure used to quote yields on bills, notes, and bonds.
Bivariate risk	The probability of default on an asset, which is the combination of the probabilities of default of two obligors or counterparties.

Cancellation options	Cancellation options allow for early termination of the contract without exchange of principal. These options can be used in case of a default to cancel the contract for the part of the loss.
Cash flow structure	A CDO that uses the cash obtained by issuing the notes to the investors to buy assets.
Closing	The date on which the transaction is closed.
Collateral	Assets that have value to both a borrower and a lender and which the borrower pledges to the lender in connection with the funds borrowed. The lender can use the pledged assets to recover some or all of the funds loaned if the borrower fails to honour the terms of the loan agreement.
Collateral Manager	An entity that manages a portfolio of assets, usually in CDO transactions.
Collateralised Debt Obligation	Security backed by a pool of various types of debt, which may include corporate bonds sold in the capital markets, loans made to corporations by institutional lenders, and tranches of securitisations.
Collateralised Loan Obligation	A security backed by a pool of loans made to corporations by institutional lenders, usually commercial banks.
Commercial Mortgages backed security	Securities backed by one or more pools of mortgage loans. CMBS are backed by one or more loans secured by commercial properties, which may include multifamily housing complexes, shopping centres, industrial parks, office buildings, and hotels.
Counter party risk	The risk embedded in any contract where one party makes payments to another. Usually used in CDOs for swaps and derivatives that the SPE (issuing the notes) enters into.
Credit Default Swap	A CDS is a contract whereby the protection seller agrees to pay to the protection buyer the settlement amount if certain credit events occur. In exchange for this protection, the protection buyer will pay the protection seller a premium.
Credit Derivatives	Capital market instruments designed to transfer credit risk from one party to another; such instruments include CDSs, total return swaps, and credit-linked notes.
Credit risk	The risk that a lending party will not be repaid at all, or will be

	repaid less than the amount owed, or will be repaid over a longer time period than was originally agreed.
Currency risk	See foreign exchange risk.
Currency swap	A derivative contract entered into with a counterparty to exchange one currency for another during the life of a structured finance transaction (or for a period thereof).
Default	A failure by one party to a contractual agreement to live up to its obligations under the agreement; a breach of a contractual agreement.
Diversification	Diversification strives to smooth out unsystematic risk events in a portfolio so that the positive performance of some investments will neutralise the negative performance of others.
Equity Piece	Usually the first-loss piece in a securitisation (see "First-Loss Piece").
Euro Interbank Offered Rate (EURIBOR)	The interest rate at which Interbank term deposits denominated in Euros are offered by one prime bank in the Euro zone to another prime bank in the Euro zone. EURIBOR is established by a panel of about 60 European banks. As with LIBOR, there are EURIBOR rates for deposits of various maturities.
Foreign Exchange Rate	A foreign exchange rate (FX rate) measures the value of a foreign currency in terms of one unit of the domestic currency.
Foreign exchange risk	The type of risk that results from uncertainties with respect to future foreign exchange rates.
First loss piece	The class within a structured finance transaction (or synthetic instrument) that is first to absorb losses in the underlying collateral or reference index. Often referred to as the "equity piece" of a transaction, or reserve fund.
Hedging	General term used to refer to strategies adopted to offset investment risks. Examples of hedging include the use of derivative instruments to protect against interest rate or currency risks, and investment in assets whose value is expected to rise faster than inflation to protect against inflation.
Interest Coverage Test	A coverage test used to measure whether the SPV receives sufficient interest proceeds to fulfil its liabilities. The interest

	coverage test divides the interest proceeds by the interest liabilities.
Interest proceeds	The interest received on the collateral owned by the SPV.
Interest rate risk	The risk that a security's value will change due to a change in interest rates; for a deposit-taking institution, the risk that the interest earned on assets acquired in a lower interest rate environment will not be sufficient to service the payments required in connection with liabilities incurred in a higher interest rate environment.
Issuer	The party that has authorised the creation and sale of securities to investors. In the case of a securitisation, the issuer is usually set up as an SPE in a jurisdiction that offers a favourable legal regime in terms of the ability to achieve bankruptcy-remote status for the issuer and the security arrangements provided for the investors and which affords favourable the tax treatment. Common jurisdictions used for establishing SPEs are England (for U.K. transactions), Italy (for Italian Law 130 transactions), Ireland, The Netherlands, Luxemburg, Jersey, Cayman Islands, and the State of Delaware, U.S. (for CP issuing vehicles).
Junior notes	A class of securities that is the lowest class of rated notes in a capital structure.
Like-for-like structure	Structure which applies proceeds denominated in a currency to the liability in such currency.
Liquidity risk	The risk that there will be a limited number of buyers interested in buying an asset, usually a financial asset, if and when the current owner of the asset wishes to sell it.
Loan Market Association	The organisations responsible for the creation of standardised loan documentation.
London Interbank Offered Rate (LIBOR)	The rate of interest that major international banks in London charge each other for borrowings. There are LIBOR rates for deposits of various maturities.
Marco hedge	An investment technique used to eliminate the risk of a portfolio of assets. In most cases, this would mean taking a position that offsets the whole portfolio. But this technique is difficult in practice because there is rarely one asset that will offset the risk of a

	broader portfolio, so applying a macro-hedge most likely requires taking an offsetting position in each individual asset.
Market value Structure	Market value CDO transactions involve issuers designed to purchase and actively manage a diversified pool of financial assets. Structurally, they are similar to cash flow CDOs because their capital structures consist of a series of debt and equity classes.
Monte Carlo Simulation	An analytical technique that performs a large number of simulations using values selected from predefined distributions for uncertain variables. The distribution of results can be analysed to examine the expected simulation outcomes, but more importantly to assess the probability of an outcome where a user would exceed acceptable limits.
Multi-Currency Instrument	A financial instrument denominated in more than one single currency.
Multi-Currency Revolver	A revolving facility that can be drawn in more than one currency.
Natural hedge	A type of hedging strategy which attempts to match the assets and liabilities.
Negative carry	Typically where assets mature or prepay, and the proceeds have not yet been invested. Consequently, part of the portfolio does not yield as much as expected, hence creating a shortfall of cash compared with liabilities.
Non-idiosyncratic risk	Risk which cannot be diversified away e.g. systemic risk.
Notional Amount	The balance that is used as the basis for calculating the interest due with respect to an obligation that either has no principal balance or has a principal balance that is not the balance used for calculating interest.
Offering Circular	A disclosure document used in marketing a new securities issuance to prospective investors. The offering circular describes the related transaction, including the characteristics of each class of securities to be issued (such as the basis for interest payments, credit rating, expected average life, and priority with respect to other classes). In the case of a securitisation, the offering circular also provides information about the underlying assets, including the type of assets and their credit quality. The offering circular is usually prepared by the lead manager of the securities issuance and its legal advisors.

Originator	An entity that underwrites and makes loans; the obligations arising with respect to such loans are originally owed to this entity before the transfer to the SPE.
Overcollateralisation	Overcollateralisation is the granting of security over assets having a value greater than the quantum of the debt being secured. It is sometimes used as a form of credit enhancement in certain asset-backed transactions. For example, an issuance of £75 million of senior securities might be secured by a pool of assets valued at £100 million, in which case the overcollateralisation for the senior securities would be 33%.
Overcollateralisation Test	Coverage test measuring the overcollateralisation of the structure.
Par Value	A dollar amount that is assigned to a security when representing the value contributed for each share in cash or goods.
Pari-passu	Two securities or obligations having equal rights to payment.
Pass-through	This term is used in the priority of payments where all principal payments are passed through to note holders, as received in the order of priority, until the notes are redeemed.
Pay-through	Special purpose entity structure which allows for reinvestment of cash flows, restructuring of the cash flows, and the purchase of additional collateral.
Perfect Asset Swap	A perfect asset swap (PAS) is an agreement whereby party A agrees to make payments to a party B based on a set rate, either fixed or variable, and party B agrees to make payments to party A based on the return of an underlying asset. The returns on the underlying asset include the income that the asset generates, as well as any capital gains or losses. PASs are often used in hybrid CDOs, where the portfolio may contain both cash assets and PASs based on cash assets.
Portfolio hedge	See macro hedge.
Portfolio manager	An individual or institution that manages a portfolio of investments; also called a money manager.
Prepayment risk	The risk that the yield on an investment will be adversely affected if some or the entire principal amount invested is repaid ahead of

	schedule, or more rapidly than expected. More generally, prepayment risk can also be taken to include extension risk (which is related to the repayment of principal more slowly than expected), and contraction risk (which is related to the repayment of principal more quickly than expected).
Principle proceeds	Proceeds obtained by the SPV due to (p)repayment of the notional value of the collateral.
Priority of payments	The order in which the (rated) notes receive their interest and principle (p)repayments.
Pro Rate pay	A priority of payments whereby different tranches of a transaction are simultaneously receiving principal, as opposed to a sequential priority of payment (whereby only one tranche is receiving principal at any given time).
Quanto swap	See currency swap.
Ramp-up period	The period after the original closing date in which the collateral manager buys additional collateral to meet the documented limits.
Redenominating	The process of changing the currency value on a financial security.
Reinvestment period	The period in which the collateral manager is allowed to reinvest (unscheduled) (p)repayments of principle proceeds.
Reinvestment risk	The risk that the yield on an investment will be adversely affected if the interest rate at which interim cash flows can be reinvested is lower than expected.
Residential Mortgage backed security	RMBS are securities that involve the issuance of debt that is secured by a pool of mortgage loans that have a lien over on residential properties.
Revolving Credit Facility	A line of credit where the customer pays a commitment fee and is then allowed to use the funds when they are needed. It is usually used for operating purposes, fluctuating each month depending on the customer's current cash flow needs.
Security	A type of secured debt in the form of a loan.
Senior notes	A tranche of a structured finance transaction that is most senior in the priority of payments for receipt of principal and interest from the underlying assets (particularly where there is not sufficient

	cash flow to fully pay all classes of note holders), as well as for the absorption of losses from those assets.
Sequential pay	The most basic type of payment priority in a structured finance transaction, by which most (or all) tranches receive regular interest payments, but principal payments are directed initially only to the first tranche (until it is completely retired), and then to the second tranche (until it is too is retired), and so forth, until the entire structure is paid off or called.
Special Purpose Entity	Also referred to as a "bankruptcy-remote entity" whose operations are limited to the acquisition and financing of specific assets. The SPV is usually a subsidiary company with an asset/liability structure and legal status that makes its obligations secure even if the parent company goes bankrupt.
Special Purpose Vehicle	See Special Purpose Entity
Stress Testing	The process used by Standard & Poor's to evaluate whether the assets that will form the collateral for a securitisation are likely to produce sufficient cash flows under varying stressful economic scenarios to make principal and interest payments due on the related securities. The scenarios generally include a "worst case" and provide an indication of whether the proposed structure and level of credit enhancement is sufficient to achieve a particular credit rating for some or all of the various tranches issued in connection with the transaction.
Structured Finance	A type of financing in which the credit quality of the debt is assumed to be based on a direct guarantee from a creditworthy entity or on the credit quality of the debtor's assets, with or without credit enhancement, rather than on the financial strength of the debtor itself.
Structuring Bank	The investment bank responsible for co-ordinating the execution of a securitisation with respect to the originator/client, various law firms, rating agencies, and other third parties. Typically, the structuring bank performs a due diligence exercise with respect to the assets to be securitised and the capacity of the servicer. This exercise includes the identification of historical information and often an asset audit. The structuring bank is also responsible for developing the legal structure of the transaction, which must be documented, and for identifying and resolving accounting and tax issues. In the case of a public issue, the structuring bank oversees the preparation of an information memorandum or offering circular

	to be used for the offering and listing of the related securities. The structuring bank ensures that the transaction complies with local regulatory requirements, if any (such as approvals by any relevant bank commission or listing authority).
Subordinated Class	A class of securities with rights that are subordinate to the rights of other classes of securities issued in connection with the same transaction; subordination usually relates to the rights of holders of the securities to receive promised debt service payments, particularly in situations in which there is not sufficient cash flow to pay promised amounts to the holders of all classes of securities, but may it also be related to the note holder's right to vote on issues related to the operation of the transaction.
Swap	An agreement under which two counterparties agree to exchange one cash flow stream for another. These can include interest rate swaps, currency swaps, or swaps to change the maturities or yields of a bond portfolio.
Swaptions	The option to enter into an interest rate swap. In exchange for an option premium, the buyer gains the right but not the obligation to enter into a specified swap agreement with the issuer on a specified future date.
Synthetic structure	A CDO transaction in which the transfer of risk is affected through the use of a credit derivative as opposed to a true sale of the assets.
Systemic risk	The risk inherent to the entire market or entire market segment.
Tranche	A class of notes in a structured finance transaction that share the same general characteristics in terms of, for example, yield, average life, or priority of payments.
Trustee	Third party, often a specialist trust corporation or part of a bank, appointed to act on behalf of investors. In the case of a securitisation, the trustee is entrusted with responsibility for reaching certain key decisions that may arise during the life of the transaction. The role of the trustee may also include holding security over the securitised assets and control over cash flows. It is often a requirement of listing ABS that an independent trustee be appointed. Trustees receive regular reports on the performance of

	the underlying assets in order to check whether, for instance, cash flow procedures are being followed. Subject to appropriate indemnity and other protections, the trustee is also typically responsible for finding a replacement servicer when necessary, taking up legal proceedings on behalf of the investors, and, as the case may be, for selling the assets in order to repay investors. To enable the trustee to perform its duties and to provide adequate remuneration, it receives a fee paid senior to all other expenses and a senior ranking indemnity to cover all unexpected costs and expenses.
Variable Funding Note	VFNs are issued in certain CDO transactions to counter so-called negative carry arising when the issuer invests some of its note proceeds in revolving or "delayed-draw" loans. These VFNs are typically issued as the most senior class of notes in a sequential pay senior/sub capital structure.
Warehouse	To acquire assets with the intention to sell them to the SPV.
Waterfall	The rules by which the cash flow available to an issuer is allocated to meet the expenses, payments to transaction counterparties, and the debt service payments owed to holders of the various classes of security issued in connection with that transaction.

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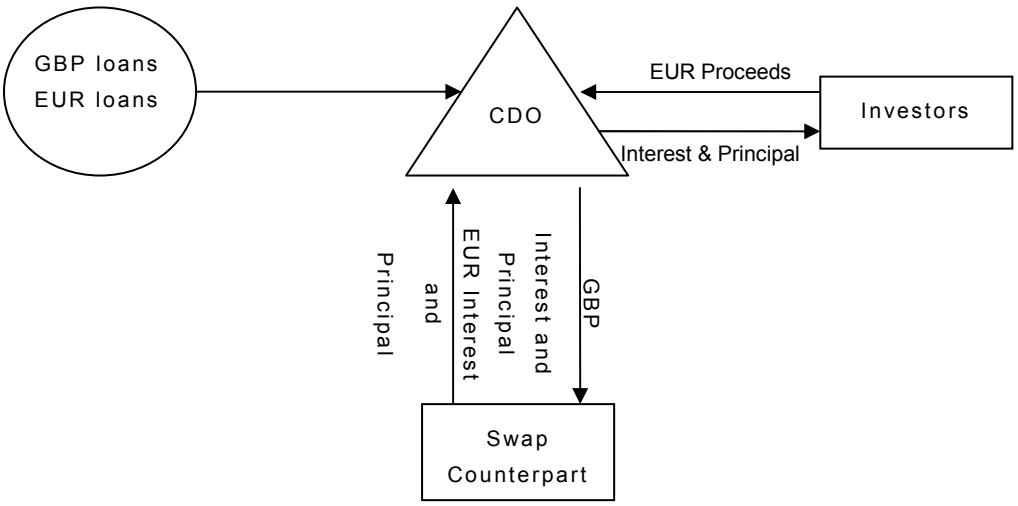
Appendix

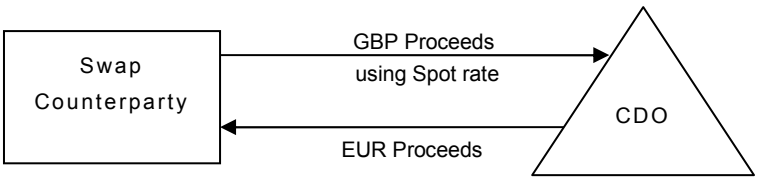
A.1 Perfect asset swap

Transaction Structure



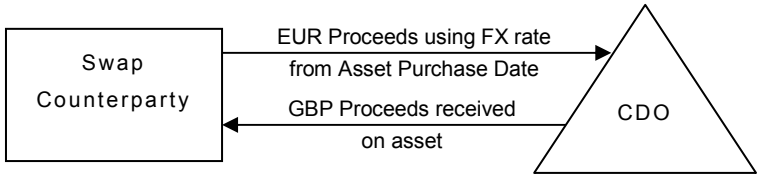
Swapping of Principal Amount on Asset Purchase Date (assume GBP asset)

- CDO needs to convert EUR proceeds received from Investors to GBP to purchase asset



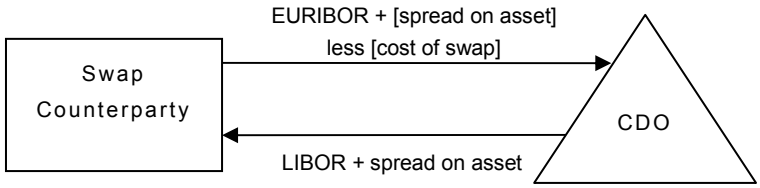
Periodic Principal Payments under the Perfect Asset Swap

- Receiving EUR equivalent of the GBP principal from the asset using the FX rate from the asset purchase date removes all FX risk from CDO.
- The swap counterparty estimates the risk of receiving (p)repayments or defaults on the asset and hedges its position in the market. However, the swap counterparty would take on any FX risk with respect to unanticipated prepayments.



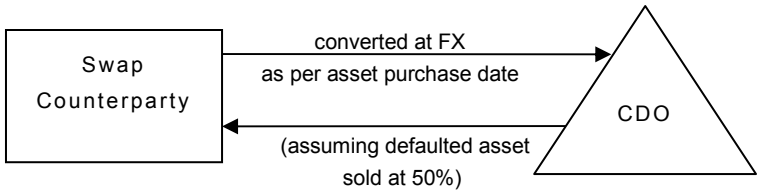
Periodic Interest Payments under the Perfect Asset Swap

- Both parties are relatively hedged for the EURIBOR/LIBOR portion of the interest payments as this will tend to reflect the exchange rates.
- The exchange of the "spread on the asset" is not hedged. The "cost of swap" covers this basis risk on the exchange rate as well as compensates the swap counterparty for the default risk on the asset in the event that the swap is terminated. The "cost of swap" depends on the size of the spread income as well as the tenor of the loan. This is summarised in the diagram below.



Payments under the Perfect Asset Swap upon Default of Asset

- After an asset default there is a "recovery period" of [12] months.
- During the "recovery period" any interest or principal proceeds recovered from the asset may be swapped from GBP to Euro via the perfect asset swap.
- If the defaulted asset is sold during the "recovery period" the GBP can be swapped to EUR via the perfect asset swap.
- After the "recovery period" the swap terminates and there are no further payments under the swap. There are no termination payments due by either party.
- In such a situation after termination, the swap counterparty could have a positive marked to market value on the swap; however, this can never be realised. The "cost of swap" would likely be priced accordingly to compensate for this. Mezzanine or second secured assets have higher "cost of swap" than senior secured loans.



A.2 European CDO of Leveraged Loans Rated By Standard & Poor's As Of Dec. 31, 2006

Transaction name	Closing date	Asset manager	Pool size (incl. cash) (Mil.)	Currency Hedge
Avoca CLO IV PLC	1/5/2006	Avoca Capital Holdings Ltd.	450.94	(Perfect) Asset Swap
Dryden X-Euro CLO 2005 PLC	1/17/2006	Pramerica Ivestment Management Inc	399.95	natural hedge
Hyde Park CDO B.V.	2/23/2006	Blackstone Debt Advisors LP	488.18	(Perfect) Asset Swap
Magi Funding I PLC	2/23/2006	Henderson Global Investors Ltd.	291	(Perfect) Asset Swap
Cheyne Credit Opportunity CDO I B.V.	3/3/2006	Cheyne Capital Management Ltd.	990	(Perfect) Asset Swap
BACCHUS 2006-1 PLC	3/15/2006	IKB Deutsche Industriebank AG	394.45	(Perfect) Asset Swap
Gresham Capital CLO 1 B.V.	3/23/2006	Investec Bank (UK) Ltd	286.89	VFN/RCF
Wood Street CLO II B.V.	3/29/2006	Alcentra Ltd.	389.87	(Perfect) Asset Swap
Mercator CLO I PLC	4/6/2006	NAC Management (Cayman) Ltd. (New Amsterdam Capital)	400.82	(Perfect) Asset Swap
Harvest CLO III PLC	4/20/2006	Mizuho Corporate Bank Ltd.	650	Portfolio hedge
Eaton Vance CDO VII PLC	4/25/2006	Eaton Vance Management	387.07	natural hedge
Alpstar CLO 1 PLC	4/27/2006	Alpstar Management (Jersey) Ltd.	323.26	Portfolio hedge
GSC European CDO III S.A.	5/17/2006	GSCP (NJ) L.P.	407.4	(Perfect) Asset Swap
European Enhanced Loan Fund S.A.	5/18/2006	PIMCO Europe Ltd.	383	Portfolio hedge
RMF Euro CDO IV PLC	5/23/2006	RMF Investment Management	437	(Perfect) Asset Swap

Leopard CLO IV B.V.	5/23/2006	M&G Investment Management Ltd.	375	(Perfect) Asset Swap
Harbourmaster Pro-Rata 1 B.V.	5/31/2006	Harbourmaster Capital Ltd.	850	VFN/RCF
Dalradian European CLO I B.V.	5/31/2006	Elgin Capital LLP	341	natural hedge
Grosvenor Place CLO I B.V.	6/8/2006	CQS Cayman L.P.	393.5	VFN/RCF
Halcyon Structured Asset Management European CLO 2006-I B.V.	6/21/2006	Halcyon Structured Asset Management L.P.	385	VFN/RCF
Avoca CLO V PLC	6/23/2006	Avoca Capital Holdings Ltd.	450	(Perfect) Asset Swap
Wood Street CLO III B.V.	6/27/2006	Alcentra Ltd.	536.32	(Perfect) Asset Swap
Harvest CLO IV PLC	6/29/2006	Mizuho Corporate Bank Ltd.	750	(Perfect) Asset Swap
Cadogan Square CLO II B.V.	6/29/2006	CS Alternative Investments	450	(Perfect) Asset Swap
Laurelin B.V.	7/20/2006	GoldenTree Asset Management, L.P.	395	VFN/RCF
Nash Point CLO	7/27/2006	Sankaty Advisors LLC	491.12	(Perfect) Asset Swap
Vallauris II CLO PLC	7/26/2006	Natexis Banques Populaires	300	(Perfect) Asset Swap
North Westerly CLO III B.V.	8/1/2006	NIBC Bank N.V.	400	(Perfect) Asset Swap
Marquette US/European CLO, P.L.C.	8/3/2006	LightPoint Capital Management LLC	200.53	natural hedge
Theseus European CLO S.A.	8/4/2006	INVESCO Senior Secured Management Inc.	325	(Perfect) Asset Swap
DRYDEN XIV - EURO CLO 2006 PLC	8/9/2006	Pramerica Investment Management Inc	450	Portfolio hedge
Duchess VI CLO B.V.	8/18/2006	Babson Capital Europe Limited	492.07	VFN/RCF
BACCHUS 2006-2 PLC	8/18/2006	IKB Deutsche Industriebank AG	400	(Perfect) Asset Swap
Oak Hill European Credit Partners I PLC	8/20/2006	Oak Hill Advisors (Europe), LLP	440	(Perfect) Asset Swap
Adagio III CLO PLC	8/21/2006	AXA Investment Managers Paris S.A.	499	(Perfect) Asset Swap
Harbourmaster Pro-Rata CLO 2 B.V.	8/23/2006	Harbourmaster Capital Ltd.	587.5	VFN/RCF

Jubilee VI	8/25/2006	Alcentra Ltd.	388	(Perfect) Asset Swap
Highlander Euro CDO B.V.	9/7/2006	Highland Capital Management Europe Ltd.	487.28	(Perfect) Asset Swap
eurocredit CDO V PLC	9/14/2006	J.P. Morgan Chase Bank, N.A.	581.85	(Perfect) Asset Swap
Euro-Galaxy CLO B.V.	9/27/2006	AIG Global Investment Corp. (Europe) Ltd.	375	(Perfect) Asset Swap
Leveraged Finance Europe Capital IV B.V.	10/17/2006	BNP Paribas	301	(Perfect) Asset Swap
Gresham Capital CLO II B.V.	10/18/2006	Investec Bank (UK) Ltd.	286.5	VFN/RCF
CELF Loan Partners III PLC	10/24/2006	CELF Investment Advisors Ltd.	500	(Perfect) Asset Swap
Prospero CLO II B.V. / Prospero CLO II Inc.	10/24/2006	Cooeperative Centrale Raiffeisen-Boerenleenbank B.A.	254.09	natural hedge
Regent's Park CDO B.V.	10/26/2006	Blackstone Debt Advisors L.P.	585.04	(Perfect) Asset Swap
Avoca CLO VI PLC	11/16/2006	Avoca Capital Holdings	500	(Perfect) Asset Swap
Aquilae CLO II PLC	11/17/2006	Henderson Global Investors Ltd.	292.74	(Perfect) Asset Swap
Jubilee CDO VII B.V.	11/20/2006	Alcentra Ltd.	533.14	VFN/RCF
Harbourmaster CLO 7 B.V.	11/22/2006	Harbourmaster Capital Ltd.	900	(Perfect) Asset Swap
Dalradian European CLO II B.V.	11/23/2006	Elgin Capital LLP	389.1	VFN/RCF
Versailles CLO M.E. I PLC	11/29/2006	Calyon CLO Management Europe	329.65	(Perfect) Asset Swap
Skellig Rock B.V.	11/30/2006	AIB Capital Markets PLC	412	(Perfect) Asset Swap
Egret Funding CLO I PLC	12/7/2006	Egret Capital LLP	410	(Perfect) Asset Swap
Gresham Capital CLO III B.V.	12/13/2006	Investec Bank (UK) Ltd.	575	VFN/RCF
Highlander Euro CDO II B.V.	12/14/2006	Highland Capital Management Europe Ltd.	686	(Perfect) Asset Swap
Duchess VII CLO B.V.	12/14/2006	Babson Capital Europe Ltd.	490	VFN/RCF
Harbourmaster CLO 8 B.V.	12/14/2006	Harbourmaster Capital Ltd.	500	(Perfect) Asset Swap
GSC European CDO I-R S.A.	12/15/2006	GSCP (NJ) L.P.	336	(Perfect) Asset Swap
Lombard Street CLO I PLC	12/15/2006	KBC Financial Products UK Ltd.	341	VFN/RCF
Green Park CDO B.V.	12/18/2006	Blackstone Debt Advisors L.P.	451.75	(Perfect) Asset Swap
Cadogan Square CLO III B.V.	12/19/2006	Credit Suisse International	486.04	(Perfect) Asset Swap
eurocredit CDO VI PLC	12/20/2006	Intermediate Capital Managers Ltd.	485	VFN/RCF
Cairn CLO I B.V.	12/20/2006	Cairn Financial Products Ltd.	340.9	VFN/RCF

eleX Alpha S.A.	12/21/2006	Deutsche Asset Management	387	VFN/RCF
Avoca CLO IV PLC	1/5/2006	Avoca Capital Holdings Ltd.	450.94	(Perfect) Asset Swap
Dryden X-Euro CLO 2005 PLC	1/17/2006	Pramerica Ivestment Management Inc	399.95	natural hedge

A.3 European CDO of Leveraged Loans Rated By Standard & Poor's As Of Jun. 1, 2007

Transaction name	Closing date	Asset manager	Pool size (incl. cash) (Mil. ?)	Currency Hedge
Grosvenor Place CLO II B.V.	15-Jan-07	CQS (UK) LLP	317.05	VFN/RCF
Halcyon Structured Asset Management European CLO 2006-II B.V.	25-Jan-07	Halcyon Structured Asset Management L.P.	400.00	VFN/RCF
Morgan Stanley Investment Management Garda B.V.	25-Jan-07	Morgan Stanley Investment Management Ltd.	317.05	(Perfect) Asset Swap
Queen Street CLO I B.V.	25-Jan-07	Indicus Advisors LLP (London) Dependent:	317.05	(Perfect) Asset Swap
Mercator CLO II PLC	25-Jan-07	NAC Management (Cayman) Ltd. (New Amsterdam Capital)	403.69	(Perfect) Asset Swap
Wood Street CLO IV B.V.	25-Jan-07	Alcentra Ltd.	535.18	(Perfect) Asset Swap
Cordatus CLO I PLC	30-Jan-07	CVC Cordatus Group Ltd.	440.00	VFN/RCF
LightPoint Pan-European CLO 2006 plc	31-Jan-07	LightPoint Capital Management LLC	293.50	(Perfect) Asset Swap
Kintyre CLO I PLC	14-Mar-07	Plemont Portfolio Managers Ltd.	338.00	(Perfect) Asset Swap
Dryden XV EURO CLO 2006 PLC	15-Mar-07	Pramerica Investment Management Inc.	439.3	VFN/RCF
Eaton Vance CDO X PLC	22-Mar-07	Eaton Vance Management	484.00	VFN/RCF
Dalradian European CLO III B.V.	28-Mar-07	Elgin Capital LLP	438.10	VFN/RCF
GSC European CDO IV S.A.	28-Mar-07	GSCP (NJ) L.P.	392.12	(Perfect) Asset Swap
Alpstar CLO 2 PLC	4-Apr-07	Alpstar Management (Jersey) Ltd.	585	VFN/RCF
eurocredit CDO VII PLC	4-Apr-07	Intermediate Capital Managers Ltd.	317.05	VFN/RCF
Penta CLO I S.A.	4-Apr-07	Penta Management Ltd.	400.00	(Perfect) Asset Swap
RMF Euro CDO V PLC	4-Apr-07	Pemba Credit Advisors	550.00	VFN/RCF
Avoca CLO VII PLC	5-Apr-07	Avoca Capital Holdings	700.00	(Perfect) Asset Swap

BACCHUS 2007-1 PLC	18-Apr-07	IKB Deutsche Industriebank AG	442	VFN/RCF
Highlander Euro CDO III B.V.	19-Apr-07	Highland Capital Management Europe Ltd.	783.50	(Perfect) Asset Swap
Ares Euro CLO I B.V.	19-Apr-07	Ares Management Ltd.	350.00	(Perfect) Asset Swap
Hudson CLO I B.V.	19-Apr-07	Aladdin Capital Management UK LLP	400.00	VFN/RCF
Harvest CLO V PLC	26-Apr-07	Mizuho Investment Management (U.K.) Ltd.	632.00	VFN/RCF
CELF Loan Partners IV PLC	3-May-07	CELF Investment Advisors Ltd.	583.10	VFN/RCF
Harbourmaster CLO 9 B.V.	8-May-07	Harbourmaster Capital Ltd.	750.75	VFN/RCF
Jubilee CDO I-R B.V.	8-May-07	Alcentra Ltd.	874.40	(Perfect) Asset Swap
Malin CLO B.V.	10-May-07	Babson Capital Europe Ltd.	485	VFN/RCF
Resource Europe CLO I B.V.	16-May-07	Resource Europe Management Ltd.	292.22	(Perfect) Asset Swap
Leopard CLO V B.V.	16-May-07	M&G Investment Management Ltd.	388.00	(Perfect) Asset Swap
Halcyon Structured Asset Management European CLO 2007-1 B.V.	24-May-07	Halcyon Structured Asset Management L.P.	586.20	VFN/RCF
Neptuno CLO I B.V.	24-May-07	Caja de Ahorros y Monte de Piedad de Madrid	485.00	VFN/RCF
Cadogan Square CLO IV B.V.	30-May-07	Credit Suisse International	487.40	(Perfect) Asset Swap
Oak Hill European Credit Partners II PLC	12-Jun-07	Oak Hill Advisors (Europe), LLP	450.00	VFN/RCF
Queen Street CLO II B.V.	26-Jun-07	Indicus Advisors LLP	437.88	(Perfect) Asset Swap
ACA Euro CLO 2007-1 PLC	28-Jun-07	ACA Capital Management (U.K.) Pte. Ltd.	389.70	VFN/RCF
Wood Street CLO V B.V.	29-Jun-07	Alcentra Ltd.	483.00	VFN/RCF

A.4 European CDO of Leveraged Loans Rated by Standard & Poor's including MCIs

The following table provides an overview of the European CDO of Leveraged Loans including a natural hedge and rated by Standard & Poor's during the period start at January 2006 and ending at June 2007. The table was created based on the information found in the indenture of the mentioned transactions below.

Transaction name	Closing date	Payments on MCI		Currency hedging					Interest proceeds Waterfall				Principle proceeds Waterfall				Notable Features
		Interest on MCI (BPs + 3 month EURIBOR)	**Commitment fee on MCI** (BPs)	**Duo currency structure ? (Y/N)**	**MCI used to purchase term loans (Y/N)**	**MCI**	**foreign currency options**	**Recognition of defaults**	**Ranking MCI**	**Pro-rata or like-for-like structure**	**During the Re-investments period**	**Currency con-version**	**Ranking MCI**	**Pro-rata or like-for-like structure**	**During the Re-investments period**	**Currency con-version**	
						Store amount drawn per currency(PC) or store the aggregate(A)	*Purchased at time of default (D) or at closing(C)*	*At time of default (D^{Vii}) / at time of recovery(R)*	*Pari-passu (P) or Senior (S) to senior notes*	*Pro-rata structure (PR) or like-for-like structure(L)*	*Use excess interest proceeds to repay the balance on the MCI:* at the desecration of the CM (D), Senior to (S), junior to reinvestment (J) or no repayment.(N)	*Convert at predetermined exchange rate(P) or convert at spot(S)*	*Pari-passu (P) or Senior (S) to senior notes*	*Pro-rata structure (PR) or like-for-like structure(L)*	*Use principle proceeds to repay the balance on the MCI:* at the desecration of the CM (D), Senior to (S), junior to reinvestment (J) or no repayment.(N)	*Convert at predetermined exchange rate(P) or convert at spot(S)*	
Dryden X-Euro CLO 2005 PLC	1/17/2006	26*	13	Y	N		D	R	P	PR	N	S	P	PR	N	S	This structure relies on a natural hedge through the matching of Euro-denominated and Sterling-denominated asset amounts and receivables against, respectively, Euro-denominated and Sterling-denominated note principal amounts and interest amounts payable. Foreign assets or GBP-assets not covered by the natural hedge are hedged using foreign exchange options or asset-specific swaps. The structure includes a revolving facility denominated in a single currency, which remains undrawn at closing. Draw amounts on the revolver are either redeemed at the interest payment date or converted to class-A senior rated notes.
Gresham Capital CLO 1 B.V.	3/23/2006	34*	17	N	Y	PC	C	R	P	L	N	S	S	L	J	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with “refinance Class A1 notes”, subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. The structure further includes “Break funding costs” which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.

Eaton Vance CDO VII PLC	4/25/2006	33	16.5	Y	Y	PC	C	R	P	PR	D	S*	P	PR	N	S	The currency mismatches in the Eaton Vance transaction are mitigated by a dual-currency capital structure (in U.S. dollars and Euros), and the use of foreign currency call options in either currency. This structure includes the notable feature that the drawn amounts under the variable funding note can be refinanced with "refinance Class A1" notes for Euro draws and "Class A2 notes" for USD draws, subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility.
Dalradian European CLO I B.V.	5/31/2006	25*	16	N	Y	PC	C	R	P	L	D	S	S	L	J	S	This structure includes the notable feature that the drawn amounts in Euro under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility.
Grosvenor Place CLO I B.V.	6/8/2006	28*		Y	Y	PC	D[i]	R	P	PR	N	S	P	PR	S	S	
Halcyon Structured Asset Management European CLO 2006-I B.V.	6/21/2006	30	20	N	Y	PC	C	D	P	PR	N	S	P	PR	S	S	
Laurelin B.V.	7/20/2006	30*	20	N	Y	PC	C	D	P	PR	N	S	P	PR	J	S	The structure further includes "Break funding costs" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.
Marquette US /European CLO PLC	8/3/2006	26		Y	Y	PC	C	D[viii]	S	PR	S	S	S	PR	J	S	
Duchess VI CLO B.V.	8/18/2006	27	13.5	N	Y	PC	C	R	P	PR	N	S	P	L	S	S	This structure includes the notable feature that Sterling and Euro proceeds are distributed according to two distinct priorities of payments. Sterling proceeds are first and foremost applied to fulfil the Sterling denominated liabilities. Under the MCI agreement, the drawn amounts in Euro can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. In addition, this transaction includes a currency clean up call after expiry of the Reinvestment Period if, on any Determination Date prior to such Payment Date, the ratio of outstanding Sterling denominated Senior Debt to Euro denominated Senior Debt would be equal to at least 1.5:1
Harbourmaster Pro-Rata CLO 2 B.V.	8/23/2006	20	10	N	Y	PC	D	D	P	PR	N	S	P	L	S	S	This transaction includes a MCI overcollateralisation Test, which if not satisfied on any Determination Date, will redirect funds standing to the credit of the principle and/or interest account to be reinvested in eligible collateral.
Gresham Capital CLO II B.V.	10/18/2006		15	N	Y	PC	C	R	P	L	N	S	S	L	J	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. The structure further includes "Break funding costs" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.

Prospero CLO II B.V. / Prospero CLO II Inc.	10/24/2006	24	10	Y	Y	PC	D[ii]	D	P	PR	N	S	P	PR	N	S	This transaction includes the notable feature of a redenomination of the Class A1 tranches. The issuer could in private negotiations with any of the class A1 note holders redenominated any of the class A1 notes to any of the eligible currencies at the prevailing spot exchange rate. The structure further includes "Break funding costs" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.
Jubilee CDO VII B.V.	11/20/2006	25	15	N	Y	PC	C	D	P	PR	D	S	P	PR	D	S	The Jubilee structure furthermore includes a Class E Par Value test; if the Class E Par Value Test is not breached, Class A-R and Class A-T Notes can be redeemed on an available currency basis (i.e. GBP denominated outstanding notes being redeemed with GBP denominated proceeds and EUR denominated notes being redeemed with EUR denominated proceeds). (During the reinvestment period such redemption is to left to the discretion of the Collateral Manager).
Dalradian European CLO II B.V.	11/23/2006	30*	15	N	Y	PC	C	R	P	PR	N	S	P	PR	N	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. In addition, this structure is subjected to break up costs on any early redemption of the outstanding principle amount on the VFN.
Gresham Capital CLO III B.V.	12/13/2006	30*	20	Y	Y	PC	C	R	P	L	N	S	P	L	D	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. The structure further includes "Break funding costs" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption. During the reinvestment period and in absence of a breach in the OC-test principle proceeds in one of the "relevant" currencies will be used to repay the draw downs on the MCI in that relevant currency.
Duchess VII CLO B.V.	12/14/2006	28	18	N	Y	PC	C	R	P	PR	N	S	p	L	J	S	Similar to the Duchess VI CLO B.V. dated 8/18/2006
Lombard Street CLO I PLC	12/15/2006	31*	15.5	N	Y	PC	C	R	P	PR	J	S	P	PR	J	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. In additions, This structure is subjected to break up costs on any early redemption of the outstanding principle amount on the RCF.
Euro credit CDO VI PLC	12/20/2006	27*	18	N	Y	PC	C	D[ix]	P	PR	D	S	P	PR	D	S	The structure further includes "Make Whole amount" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.
Cairn CLO I B.V.	12/20/2006	31*	15.5	N	Y	PC	C	D[ix]	P	L	N	S	P	L	J	S	In additions, This structure is subjected to break up costs on any early redemption of the outstanding principle amount on the RCF.
EleX Alpha S.A.	12/21/2006	30*	20	N	Y	PC	C	D[ix]	P	PR	D	S	P	PR	S	S	

Grosvenor Place CLO II B.V.	1/15/2007	27*		Y	Y	PC	D [iii]	R	P	PR	N	S	p	PR	S	S	This structure is subjected to break up costs on any early redemption of the outstanding principle amount on the VFN. In addition the structure specifies a "currency adjustment event"; If on any Determination Date after the expiry of the Reinvestment Period, the difference between the Asset Balance and Liability Balance of the Issuer in any Non-Euro Available Currency exceeds £2,000,000 in the case of Sterling, or $3,000,000 in the case of USD, the Collateral manager has to take action as to mitigate this mismatch.
Halcyon Structured Asset Management European CLO 2006-II B.V.	1/25/2007	24*	12.5	N	Y	PC	C	D	P	PR	D	S	P	PR	S	S	
Cordatus CLO I PLC	1/30/2007		17	Y	Y	PC	C	R	P	PR	N	S	p	PR	S	S	In absence of a breach of the triggers, the issuer will match its Euro and Sterling assets to Euro and Sterling liabilities. Sterling amounts received by the issuer will be used to repay the VFN to the extent drawn in Sterling and the Sterling class A notes. Similarly, Euro amounts received by the issuer will be used to repay the VFN to the extent drawn in Euros, and senior fees, expenses, and amounts due under the Euro notes.
Dryden XV EURO CLO 2006 PLC	3/15/2007	30*	16	Y	Y	PC	C	R	P	PR	N	S	p	PR	S	S	This structure includes a "Currency Adjustment Event"; if on any Determination Date both during and after the Reinvestment Period, the difference between the Asset Balance and Liability Balance of the Issuer in any Non-Euro Available Currency exceeds £2,000,000 in the case of Sterling, or U.S.$3,000,000 in the case of USD the Collateral manager has to reduce his exposure or enter into currency hedge agreements, such that the mismatch does not exceed 500.000 Dollar or Sterling. In addition the structure applies a Break Funding Costs clause with regards to the early repayment of the advances on the MCI.
Eaton Vance CDO X PLC	3/22/2007	30	16	Y	Y	PC	C	R	P	L	J	S	P	L	D	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. In addition this transaction includes an optional currency redemption at the discretion of the collateral manager if, on such payment date, the principle reserve account in the respective currency exceeds 10.000.000,00 in such currency.
Dalradian European CLO III B.V.	3/28/2007	30*	15	N	Y	PC	C	R	P	PR	N	S	p	PR	N	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility. In addition, this structure is subjected to break up costs on any early redemption of the outstanding principle amount of the VFN will
Alpstar CLO 2 PLC	4/4/2007	30*	15	N	Y	PC	C	R	P	PR	N	S	P	PR	J	S	This structure includes the notable feature that the drawn amounts under the revolving credit facility can be refinanced with "refinance Class A notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility.
Eurocredit CDO VII PLC	4/4/2007	27*	18	N	Y	PC	C	D [ix]	P	PR	D	S	P	PR	D	S	The structure further includes "Make Whole amount" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.
RMF Euro CDO V PLC	4/4/2007	25.5*		N	Y	PC	C	D	P	PR	N	S	P	PR	N	S	

BACCHUS 2007-1 PLC	4/18/2007	?	?	N	Y	PC	C	D[ix]	P	PR	J	S	P	PR	N	S	The Sterling-denominated funding for these assets will provide a partial natural hedge against fluctuations in the Euro/Sterling exchange rate. To further hedge against any potential currency mismatches, at closing, the issuer will acquire a basket of Sterling-denominated call options at varying strike prices.
Hudson CLO I B.V.	4/19/2007	30	20	Y	Y	PC	C	D[ix]	P	PR	N	S	P	PR	S	S	The structure further includes "Make Whole amount" which are due when draw downs on the MCI are redeemed prior to their scheduled redemption.
Harvest CLO V PLC	4/26/2007	25*	15	Y	Y	PC	C	D[ix]	S	PR	J	S	S	PR	D	S	The application of interest proceeds for the class A-1 notes will be payable pro-rata and pari-passu amongst (i) the class A-D notes, and (ii) the class A-R notes. Principal proceeds will be distributed pro-rata between the class A-D and A-R notes. Any residual currency mismatch resulting from the imbalance of the natural hedge is mitigated using currency options purchased at closing. If a non-Euro-denominated obligation is purchased in the primary market, the collateral manager has six months to enter into an asset swap transaction.
CELF Loan Partners IV PLC	5/3/2007	27*	18	N	Y	PC	C	D[ix]	P	PR	N	S	P	PR	N	S	The CELF structure includes multiple notable features, including, but not limited to: the optionality to enter into short positions, redenominated liabilities under the VFN, refinance amounts drawn under the VFN with Class A2 notes, unusual short special redemption period (20 days where a range of 60 to 120 days is customary).
Harbourmaster CLO 9 B.V.[vi]	5/8/2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Malin CLO B.V.	5/10/2007	27	18	N	Y	PC	C	R	P	PR	N	S	p	PR	N	S	The Issuer may from time to time without the consent of the Note holders, but subject to the prior written consent of the Trustee and the satisfaction of the conditions referred to below, create and issue further securities having the same terms and conditions as the Class A-1a Notes and the Class A-1b Notes
Halcyon Structured Asset Management European CLO 2007-1 B.V.	5/24/2007	28*	15	N	Y	PC	C	D	P	PR	N	S	p	PR	D	S	This structure includes the notable feature that the drawn amount in Euro under the revolving credit facility can be refinanced with "refinance Class A1 notes", subjected to the condition that the aggregate amount of Class A notes does not exceed the sum of the Class A1 notes and the revolving credit facility.
Neptuno CLO I B.V.	5/24/2007	25*	15	N	Y	PC	C	D[ix]	P	PR	S	S	P	PR	S	S	
Oak Hill European Credit Partners II PLC	6/12/2007	28*[iv]	18	Y	Y	PC	C	D[ix]	P	PR	S	S	P	L	S	S	In addition to being long credit risk by holding debt obligations directly or through CDSs, the issuer can also be short credit risk by entering into offsetting CDSs and credit-short obligations as the protection buyer. Under these credit-short swaps, using these instruments, the issuer buys protection for a specified reference obligation that it already owns (an offsetting CDS) or one it does not (a credit-short obligation).
ACA Euro CLO 2007-1 PLC	6/28/2007	23.75*	12	N	Y	PC	C	D[ix]	P	PR	N	S	P	PR	N	S	
Wood Street CLO V B.V.[v]	6/29/2007	25*		N	Y	PC	C		P	PR		S	P	PR		S	

* 6 month EURIBOR + spread

[i] The decision to purchase options is left to the discretion of Collateral Manager. Options are likely to be purchased when any of the currency ratio tests are failed.

[ii] The decision to purchase options is left to the discretion of Collateral Manager.

[iii] The decision to purchase options is left to the discretion of Collateral Manager. Options are likely to be purchased when any of the currency ratio tests are failed.

[iV] Description based on the Fitch Ratings new issuance report as no further data on this CLO was publicly available.

[V] Margin on Drawings shall be 0.28 per cent. per annum in the case of Sterling and Euro, and 0.38 per cent per. Annum in the case of Swedish Kroner; provided in each case that the margin on Term Drawings shall be be 0.215 per cent. per annum in the case of Sterling and Euro, and 0.315 per cent per. annum in the case of Swedish Kroner.

[Vi] Description based on the presale reports of Fitch and Standard & Poor's.

[Vii] "Defaulted Amount" means with respect to a Defaulted Collateral Obligation, as of any date of determination, the Euro equivalent of an amount equal to the product of:

(i) the lower of (A) the lowest of the Rating Agencies' Recovery Rates of such Defaulted Collateral Obligation and (B) the then current Market Value of such Collateral Obligation; and

(ii) the Principal Balance of such Defaulted Collateral Obligation.

Where a Defaulted Amount is not denominated in Euro, such Defaulted Amount shall be converted into Euro using the Spot Rate.

[Viii] Similar to [Vii], except that during the Reinvestment Period, the Principal Balance of each Defaulted Obligation will be the Market Value thereof and (y) following the Reinvestment Period, the Principal Balance of each Defaulted Obligation will be the Recovery Value thereof; provided that, solely for purposes of calculating the Coverage Tests, if a Defaulted Obligation has been owned by the Issuer for 3 years or longer, the Market Value thereof shall be deemed to be zero.

[iX] a percentage of the outstanding principal amount thereof equal to the Market Value thereof, until such time as any payment is received by or on behalf of the Issuer in respect of such Collateral Debt Obligation (provided that this sub-paragraph (iii) shall not apply if the Market Value cannot be determined for any reason)

A.5 The test structures: Priority of payments

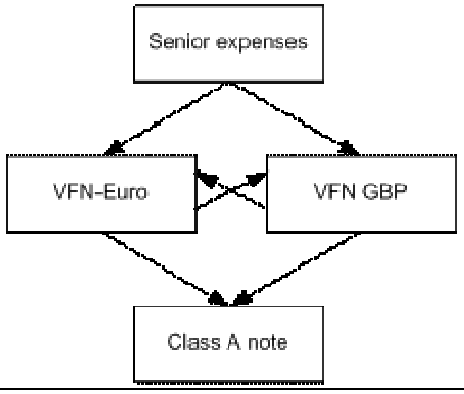
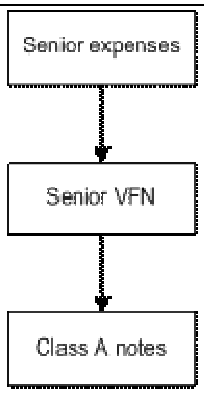
In section 4.4 8 test-structures were developed based on the various structural features found in the CLO market. These test-structures differ in the manner in which they combine the alternative rankings of the variable funding note in the waterfall, the allocation of different currencies among the differently denominated liabilities and the ability to redenominate the VFN. The consequences of incorporating these structural elements individually were already discussed in chapter 4, however this discussion lacked an explicit explanation on the consequences of combining these features in one CLO structure. This appendix will provide such an overview.

Two of the three structural features, the ranking of the VFN and the currency allocations, have a direct effect on the priority of payments used in the structures to allocate interest and principle proceeds to the notes. Therewith these features influence the amount of money allocated to the various liabilities and affect the speed with which the liabilities are redeemed. In contrast, the third feature, the ability to redenominate, affects the size of the differently denominated liabilities directly; by allowing the Collateral Manager to redenominate GBP liabilities to Euro liabilities during the reinvestment period whenever the GBP assets fall short of the GBP liabilities. This process of redenomination was elaborately explained in chapter 3. Even though the ability to redenominate does not directly influence the priority of payments, redenominating does influence the division of funds between the various notes in a pro-rata structure, when the ratio is based on the size of the respective liabilities.

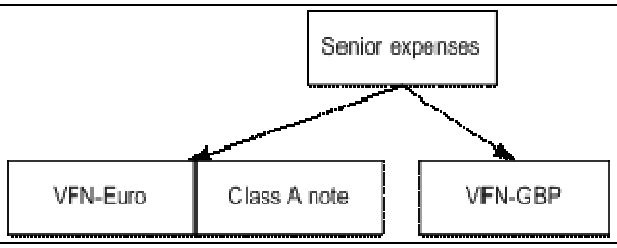
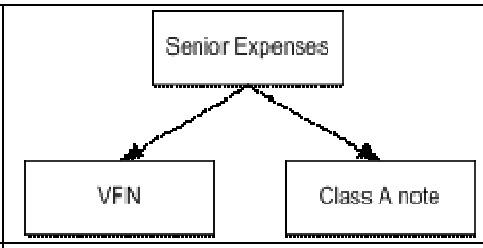
The priority of payments is affected by the first two structural features as follows:

- The ranking of the VFN determines the relative position of the VFN with regards to the senior notes and thereby the order in which funds will be allocated to these two liabilities; and
- The payment allocation options, like-for-like or pro-rata, influence the manner in which funds in different currencies is allocated to the differently denominated liabilities. Where in a like-for-like structure funds in Euro is used towards Euro denominated liabilities and Sterling is used towards Sterling denominated liabilities.

Based on these two options four different priorities of payments can be created:

	
A structure including a senior VFN and a like-for-like payment allocation, where the available interest and principle proceeds are first allocated to the portion of the VFN denominated in a similar currency. In so far	A structure including a senior VFN, but with a pro-rata payment allocation, where the available interest and principle proceeds are first allocated to the VFN on a pro-

as there is a shortfall in one of the currencies, the excess principle in the other currency will be used to cure this shortfall prior to paying the junior ranking Class A notes. This priority of payments was used in test-structures 1 & 2.	rata basis before anything will be paid to the junior ranking Class A notes. This priority of payments was used in test-structures 3 & 4.

	
A structure with a pari-passu ranking VFN and a like-for-like payment allocation. Funds denominated in a specific currency are used towards liabilities denominated in that respective currency, but unlike the senior ranking VFN, the Class A notes and the VFN are paid simultaneously. This priority of payments was used in test-structures 5-6.	A pari-passu and pro-rata structure, where all the notes are equal in seniority and the available interest and principle proceeds are allocated pro rata. This last priority of payments was used in test-structures 7 & 8.

A.6 Appendix: Monte Carlo simulation and correlation

Correlation

The CDO Evaluator, used by S&P to analyse the asset pool, addresses correlation primarily at the underlying obligor/asset-pool level and assumes that it can be expressed in terms of a pair-wise sector correlation table. The advantage of studying correlation at the obligor/asset-pool level, rather than the portfolio level, is that it allows issuers and investors to focus on the general correlation assumptions governing the performance of industries, broad asset-pool classes and the economy as a whole, rather than on the considerably less transparent relationship between securities or tranches with different positions within the capital structure of their respective issuing entities. The emphasis placed on modelling correlation in the CDO Evaluator is due to the profound effect that correlation can have on the level of SDR for various credit ratings. The CDO Evaluator uses a correlation coefficient of 0.3 within an ABS sector and 0.1 between ABS sectors. For corporate sectors, it uses 0.3 within a given industry and 0.0 between industry sectors. Table 1

Table 1: Standard & Poor's Industry and ABS Sectors	
Corporate Industry Sectors	ABS Sectors
Aerospace and defense	CDO
Air transport	ABS consumer
Automotive	ABS commercial
Beverage and tobacco	CMBS Diversified (conduit and CTL)
Radio and television	CMBS (large loan, single borrower, and single property)
Brokers, dealers, and investment houses	REITs and REOCs
Building and development	RMBS A
Business equipment and services	RMBS BandC, HELs, HELOCs, and tax lien
Cable and satellite television	Manufactured housing
Chemicals and plastics	U.S. agency (explicitly guaranteed)
Clothing/textiles	Monoline/FER guaranteed
Conglomerates	Non-FER Company Guaranteed
Containers and glass products	FFELP student loans (Over 70% FFELP)
Cosmetics/toiletries	Project finance
Drugs	
Ecological services and equipment	
Electronics/electrical	
Equipment leasing	
Farming/agriculture	
Financial intermediaries	
Food/drug retailers	
Food products	
Food service	
Forest products	
Health care	
Home furnishings	
Lodging and casinos	
Industrial equipment	
Insurance	
Leisure goods/activities/movies	
Nonferrous metals/minerals	
Oil and gas	
Publishing	
Rail industries	
Retailers (except food and drug)	
Steel	
Surface transport	
Telecommunications	
Utilities	

Monte Carlo simulation

To properly model the effect of correlation on the CDO asset pool, Standard & Poor's has adopted a Monte Carlo approach to estimating the probability distribution of default rates. Within this approach, a number of independent trials are simulated. Each trial generates a vector of random numbers equal in length to the number of assets and having the desired correlation structure. For each trial, each asset represented in this vector is then determined to have either defaulted or not, based on the value of its associated random number, in a manner calibrated to be consistent with the probability of default associated with that particular asset's credit rating. The total principal balance of defaulted assets is then tallied up and expressed as a percentage of the total portfolio principal balance. This result represents the default rate for the trial. Collecting all such observed default rates generates a probability distribution for default rates.

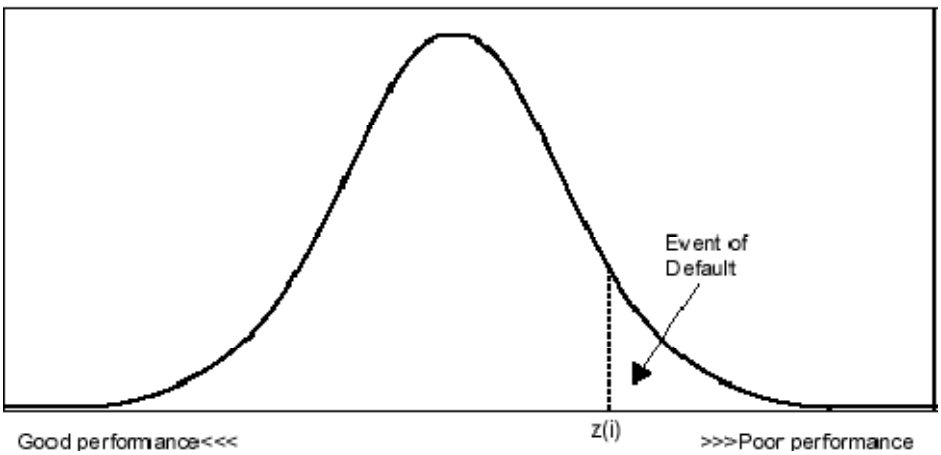
Using a Monte Carlo simulation allows S&P to capture the effect of correlation among assets, without going through a difficult if not impossible analytical process. In addition this methodology makes it possible to include the effects of other important variables, such as concentration effects due to servicers, portfolio managers, year of origination, and shared names.

Modelling Correlation

The following discussion gives a more detailed mathematical exposition of how correlation is modelled and how the Monte Carlo simulation is performed. Each asset is assumed to reflect the performance of either an underlying pool of collateral (e.g. auto loans) or the obligor. Assume that there are N assets and let X(i) denote the performance the pool/obligor supporting the i-th asset, with poor performance corresponding to large values of X(i). Hence, the event that the i-th asset defaults is equivalent to the event that X(i) exceeds some quantity z(i). The quantity z(i) is chosen so that the probability of X(i) exceeding z(i) is equal to the default probability determined for the asset, given its rating and tenor, from the asset default table (see table 2 and chart 7).

Chart 7

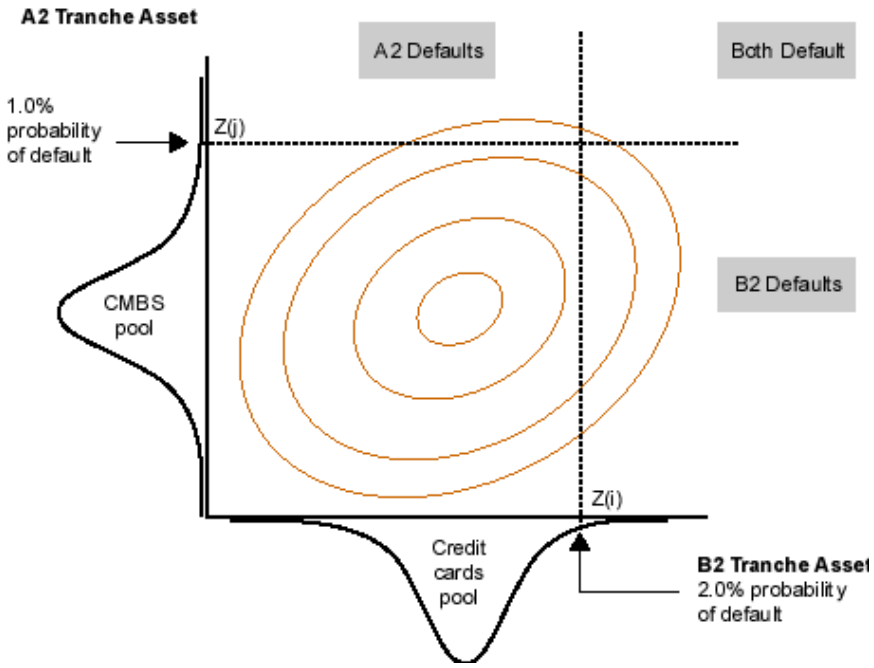
Obligor/ABS Pool Performance



It is convenient to assume that the probability distribution of X(i) is the normal distribution. Without loss of generality, it may be assumed that the mean is 0 and the standard deviation is 1. Otherwise, the variable X (i) may be transformed to have such a mean and variance, and the same transformation may be applied to z(i), which leaves the probability of the transformed random variable exceeding the transformed z(i) unchanged.

The above assumption implies that the joint distribution for the random vector X = X(1),X(2), . . ., X(N), which is the collective performance of the pools/obligors, is multivariate normal with a mean vector of 0's and a covariance matrix equal to its correlation matrix. The correlation matrix may be chosen to reflect the correlation structure that is assumed to exist among the industry and ABS sectors. That is to say, a value of 0.3 is chosen for the matrix if two pools or obligors come from the same sector, a value of 0.1 for two ABS pools not from the same sector, and 0.0 for all other off-diagonal cells. Chart 8 illustrates the joint bivariate distribution of two underlying asset pools, together with their marginal distributions. Also marked are the regions of the bivariate distribution where either or both of the two securities collateralized by their respective pools will default (see chart 8).

Chart 8
Modeling Correlation
Pool Correlation and Tranche Asset Defaults



Monte Carlo Simulation

The simulation process requires that a large number T of trials be drawn. Each such trial t is an independent realization of the random vector X. For that realization, each component X(i) of X is compared to z(i) and if it is greater, then asset i is deemed to have defaulted. The principal balances of all defaulted assets are added together and the resulting sum, dividing by the total initial portfolio balance, is the observed default rate for that trial. All trials are tabulated and used to create an estimated probability density function for default rates. The process of generating random drawings from a multivariate normal distribution with a known correlation matrix is relatively easy. For example, one may begin by generating a sequence of N independent random variables drawn from a uniform distribution. Then one may convert these into a sequence of independent random variables drawn from a normal distribution with mean 0 and variance 1 by applying the inverse normal function. These N variables may then be transformed into a multivariate normal distribution by pre-multiplying by an N by N matrix M. To obtain the desired correlation structure, the matrix M is chosen to be the Cholesky decomposition of the targeted correlation matrix.

A.7 Appendix: The EURIBOR interest rate stress curve

Euribor Interest Rate Stress Curve Generator: output S&P. All numbers indicate the percentage of Euribor.
Payment Periods per Year
2

Period	Month start	FWD	AAA UP	AA UP	A UP	BBB UP	BB UP	B UP	CCC UP	AAA DOWN	AA DOWN	A DOWN	BBB DOWN	BB DOWN	B DOWN	CCC DOWN	AAA DOWN /UP	AA DOWN /UP	A DOWN /UP	BBB DOWN /UP	BB DOWN /UP	B DOWN /UP	CCC DOWN /UP	AAA UP /DOWN	AA UP /DOWN	A UP /DOWN	BBB UP /DOWN	BB UP /DOWN	B UP /DOWN	CCC UP /DOWN
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	6	2.69	3.193	3.051	2.955	2.879	2.815	2.755	2.700	1.908	2.051	2.146	2.223	2.287	2.345	2.399	2.517	2.525	2.529	2.534	2.537	2.540	2.541	2.584	2.577	2.572	2.568	2.564	2.561	2.557
3	12	3.15	4.666	4.201	3.904	3.673	3.485	3.315	3.162	1.314	1.593	1.793	1.958	2.110	2.246	2.377	2.389	2.430	2.470	2.508	2.551	2.589	2.629	3.590	3.364	3.227	3.123	3.044	2.972	2.910
4	18	3.29	5.619	4.951	4.528	4.202	3.940	3.708	3.498	1.145	1.469	1.710	1.915	2.102	2.279	2.448	1.974	2.114	2.232	2.339	2.442	2.544	2.642	4.790	4.305	4.006	3.778	3.599	3.443	3.303
5	24	3.34	6.389	5.558	5.042	4.653	4.322	4.039	3.788	1.081	1.427	1.700	1.935	2.151	2.354	2.547	1.510	1.760	1.969	2.154	2.326	2.490	2.647	5.961	5.225	4.772	4.434	4.147	3.903	3.688
6	30	3.38	7.069	6.100	5.506	5.047	4.671	4.342	4.050	1.065	1.439	1.723	1.974	2.207	2.427	2.646	1.168	1.518	1.787	2.026	2.249	2.460	2.670	6.967	6.021	5.441	4.995	4.629	4.310	4.026
7	36	3.44	7.642	6.558	5.886	5.381	4.960	4.593	4.277	1.074	1.461	1.766	2.031	2.280	2.516	2.749	1.079	1.465	1.769	2.034	2.282	2.517	2.750	7.637	6.555	5.883	5.378	4.959	4.592	4.276
8	42	3.51	8.156	6.978	6.228	5.675	5.231	4.843	4.494	1.095	1.493	1.809	2.091	2.349	2.600	2.852	1.329	1.675	1.956	2.210	2.444	2.675	2.907	7.921	6.796	6.081	5.556	5.135	4.768	4.440
9	48	3.56	8.610	7.344	6.547	5.955	5.477	5.066	4.698	1.113	1.521	1.852	2.144	2.428	2.693	2.950	1.948	2.170	2.375	2.569	2.768	2.958	3.145	7.775	6.696	6.024	5.530	5.137	4.802	4.503
10	54	3.60	9.036	7.684	6.845	6.210	5.692	5.254	4.870	1.138	1.565	1.904	2.208	2.493	2.770	3.041	2.936	2.958	3.029	3.119	3.221	3.335	3.457	7.238	6.291	5.720	5.299	4.963	4.689	4.454
11	60	3.65	9.402	7.987	7.107	6.434	5.899	5.443	5.039	1.170	1.605	1.956	2.268	2.568	2.854	3.139	4.221	3.970	3.865	3.812	3.802	3.814	3.843	6.351	5.622	5.198	4.890	4.664	4.484	4.335
12	66	3.68	9.748	8.268	7.336	6.648	6.082	5.615	5.193	1.194	1.647	2.008	2.329	2.635	2.932	3.226	5.695	5.130	4.812	4.602	4.449	4.344	4.261	5.247	4.784	4.533	4.375	4.268	4.204	4.158
13	72	3.72	10.045	8.496	7.551	6.832	6.263	5.773	5.338	1.220	1.677	2.049	2.380	2.693	3.003	3.306	7.214	6.309	5.786	5.403	5.117	4.884	4.686	4.051	3.865	3.814	3.808	3.838	3.891	3.958
14	78	3.72	10.341	8.778	7.768	7.031	6.430	5.917	5.477	1.236	1.710	2.094	2.442	2.767	3.079	3.390	8.653	7.468	6.716	6.180	5.751	5.391	5.090	2.924	3.020	3.146	3.293	3.446	3.605	3.777
15	84	3.81	10.621	8.965	7.956	7.209	6.589	6.060	5.602	1.256	1.744	2.128	2.481	2.813	3.134	3.453	9.866	8.382	7.486	6.828	6.284	5.824	5.429	2.011	2.327	2.599	2.862	3.117	3.370	3.626
16	90	3.92	10.838	9.151	8.115	7.340	6.724	6.193	5.717	1.285	1.780	2.173	2.528	2.862	3.190	3.516	10.675	9.025	8.013	7.258	6.658	6.141	5.680	1.448	1.905	2.274	2.610	2.928	3.242	3.553
17	96	3.97	11.065	9.330	8.245	7.462	6.828	6.287	5.807	1.311	1.802	2.207	2.567	2.913	3.248	3.576	11.059	9.325	8.241	7.458	6.825	6.285	5.805	1.318	1.807	2.211	2.571	2.916	3.250	3.577
18	102	3.99	11.281	9.493	8.394	7.583	6.928	6.379	5.889	1.329	1.826	2.240	2.606	2.953	3.297	3.635	10.951	9.238	8.190	7.418	6.796	6.277	5.814	1.659	2.081	2.444	2.771	3.085	3.399	3.710
19	108	4.04	11.464	9.676	8.535	7.716	7.060	6.487	5.983	1.341	1.858	2.271	2.651	3.008	3.345	3.688	10.336	8.805	7.837	7.152	6.608	6.137	5.728	2.469	2.729	2.969	3.215	3.459	3.695	3.943
20	114	4.06	11.631	9.788	8.649	7.812	7.145	6.580	6.075	1.359	1.874	2.303	2.684	3.044	3.394	3.737	9.292	7.986	7.204	6.644	6.211	5.855	5.543	3.698	3.676	3.748	3.851	3.978	4.119	4.269
21	120	4.11	11.766	9.919	8.775	7.913	7.227	6.653	6.139	1.384	1.907	2.330	2.711	3.073	3.427	3.772	7.918	6.949	6.387	5.985	5.688	5.458	5.262	5.231	4.876	4.719	4.639	4.613	4.622	4.649
22	126	4.13	11.872	10.019	8.858	7.999	7.318	6.725	6.209	1.404	1.938	2.361	2.745	3.107	3.458	3.813	6.364	5.767	5.439	5.235	5.102	5.006	4.948	6.912	6.190	5.779	5.510	5.323	5.177	5.074
23	132	4.14	12.014	10.141	8.957	8.105	7.394	6.808	6.281	1.407	1.945	2.381	2.770	3.142	3.499	3.855	4.810	4.575	4.491	4.482	4.506	4.560	4.633	8.611	7.512	6.847	6.393	6.030	5.746	5.503
24	138	4.09	12.166	10.242	9.060	8.181	7.481	6.874	6.349	1.421	1.961	2.394	2.787	3.161	3.521	3.885	3.413	3.496	3.630	3.787	3.962	4.142	4.342	10.174	8.708	7.824	7.181	6.681	6.252	5.892
25	144	4.18	12.306	10.348	9.145	8.252	7.544	6.928	6.397	1.433	1.970	2.413	2.810	3.188	3.548	3.911	2.310	2.646	2.956	3.249	3.539	3.820	4.112	11.429	9.672	8.602	7.813	7.193	6.655	6.196
26	150	4.27	12.388	10.420	9.220	8.309	7.591	6.981	6.439	1.439	1.994	2.444	2.837	3.214	3.584	3.949	1.626	2.138	2.559	2.930	3.289	3.641	3.991	12.201	10.277	9.105	8.216	7.516	6.924	6.397
27	156	4.30	12.489	10.511	9.285	8.397	7.660	7.038	6.488	1.452	2.011	2.453	2.854	3.225	3.595	3.970	1.460	2.017	2.458	2.858	3.228	3.597	3.972	12.481	10.505	9.280	8.393	7.657	7.035	6.486
28	162	4.24	12.546	10.586	9.351	8.434	7.703	7.082	6.545	1.464	2.013	2.460	2.870	3.259	3.628	4.000	1.832	2.297	2.689	3.055	3.407	3.743	4.085	12.178	10.301	9.122	8.249	7.556	6.967	6.460
29	168	4.29	12.625	10.667	9.426	8.499	7.760	7.133	6.570	1.474	2.031	2.489	2.896	3.279	3.648	4.024	2.716	2.993	3.262	3.521	3.779	4.037	4.308	11.383	9.705	8.653	7.875	7.260	6.745	6.286
30	174	4.29	12.715	10.713	9.473	8.541	7.796	7.161	6.608	1.475	2.042	2.496	2.911	3.305	3.685	4.061	4.034	4.017	4.085	4.193	4.328	4.477	4.641	10.156	8.739	7.885	7.259	6.774	6.370	6.028
31	180	4.32	12.810	10.773	9.523	8.593	7.832	7.194	6.637	1.486	2.053	2.506	2.928	3.313	3.691	4.068	5.683	5.285	5.106	5.027	4.988	4.989	5.020	8.614	7.541	6.923	6.494	6.157	5.896	5.685
32	186	4.28	12.918	10.824	9.554	8.628	7.873	7.235	6.674	1.497	2.050	2.520	2.929	3.311	3.693	4.072	7.507	6.667	6.221	5.928	5.711	5.557	5.441	6.909	6.208	5.853	5.630	5.472	5.371	5.305
33	192	4.30	12.972	10.878	9.598	8.667	7.911	7.264	6.700	1.500	2.062	2.526	2.941	3.332	3.717	4.093	9.292	8.050	7.329	6.830	6.442	6.126	5.864	5.181	4.890	4.795	4.778	4.801	4.855	4.929
34	198	4.25	12.984	10.884	9.639	8.694	7.926	7.301	6.735	1.507	2.075	2.539	2.964	3.360	3.744	4.121	10.857	9.252	8.323	7.632	7.080	6.642	6.251	3.634	3.708	3.855	4.026	4.207	4.403	4.606
35	204	4.29	12.987	10.922	9.636	8.708	7.973	7.326	6.761	1.509	2.088	2.559	2.976	3.366	3.744	4.124	12.061	10.210	9.065	8.246	7.602	7.037	6.549	2.435	2.801	3.130	3.438	3.737	4.033	4.337
36	210	4.26	13.014	10.952	9.687	8.756	8.008	7.350	6.776	1.519	2.100	2.566	2.984	3.381	3.779	4.160	12.818	10.801	9.566	8.657	7.929	7.289	6.732	1.715	2.251	2.688	3.082	3.460	3.840	4.205
37	216	4.27	13.051	10.983	9.719	8.781	8.024	7.370	6.806	1.532	2.111	2.570	2.991	3.389	3.777	4.169	13.043	10.977	9.714	8.777	8.021	7.368	6.804	1.540	2.117	2.575	2.995	3.392	3.780	4.171
38	222	4.17	13.087	11.033	9.745	8.802	8.036	7.390	6.820	1.527	2.108	2.579	2.996	3.396	3.786	4.169	12.703	10.736	9.507	8.609	7.882	7.270	6.732	1.911	2.405	2.817	3.189	3.551	3.905	4.257
39	228	4.20	13.160	11.064	9.765	8.816	8.055	7.406	6.835	1.536	2.116	2.586	3.014	3.416	3.807	4.198	11.865	10.067	8.965	8.170	7.538	7.005	6.541	2.832	3.113	3.386	3.661	3.933	4.208	4.492
40	234	4.17	13.142	11.091	9.785	8.834	8.081	7.427	6.854	1.534	2.117	2.594	3.019	3.422	3.809	4.201	10.499	9.048	8.148	7.510	7.020	6.603	6.250	4.177	4.160	4.232	4.343	4.482	4.633	4.805
41	240	4.21	13.196	11.129	9.830	8.863	8.090	7.426	6.858	1.537	2.122	2.594	3.021	3.425	3.823	4.211	8.876	7.791	7.149	6.698	6.361	6.091	5.877	5.858	5.460	5.276	5.186	5.154	5.158	5.192
42	246	4.21	13.211	11.129	9.826	8.864	8.104	7.452	6.869	1.545	2.124	2.600	3.034	3.439	3.829	4.220	7.073	6.391	6.024	5.797	5.649	5.545	5.475	7.684	6.862	6.402	6.102	5.893	5.735	5.614
43	252	4.22	13.252	11.134	9.855	8.893	8.125	7.480	6.894	1.543	2.128	2.598	3.034	3.441	3.836	4.230	5.300	5.017	4.926	4.914	4.944	5.005	5.084	9.496	8.245	7.527	7.013	6.623	6.311	6.039
44	258	4.14	13.272	11.151	9.848	8.922	8.147	7.489	6.901	1.544	2.130	2.616	3.039	3.436	3.837	4.235	3.718	3.802	3.956	4.129	4.309	4.514	4.729	11.099	9.479	8.508	7.832	7.274	6.812	6.407
45	264	4.14	13.315	11.196	9.890	8.925	8.156	7.500	6.919	1.553	2.147	2.623	3.046	3.454	3.851	4.241	2.501	2.877	3.210	3.521	3.834	4.145	4.457	12.366	10.466	9.304	8.451	7.777	7.205	6.703
46	270	4.14	13.363	11.223	9.914	8.947	8.168	7.501	6.923	1.554	2.148	2.623	3.048	3.459	3.856	4.246	1.755	2.302	2.747	3.149	3.539	3.918	4.292	13.162	11.069	9.790	8.846	8.088	7.439	6.877
47	276	4.14	13.394	11.240	9.931	8.946	8.172	7.518	6.937	1.555	2.153	2.635	3.064	3.470	3.862	4.253	1.563	2.160	2.640	3.068	3.473	3.864	4.254	13.386	11.234	9.926	8.942	8.168	7.516	6.935
48	282	4.14	13.401	11.242	9.929	8.973	8.201	7.535	6.953	1.552	2.155	2.634	3.060	3.470	3.870	4.266	1.946	2.457	2.876	3.256	3.627	3.992	4.355	13.008	10.941	9.686	8.777	8.044	7.413	6.864
49	288	4.14	13.402	11.262	9.946	8.958	8.200	7.540	6.955	1.554	2.143	2.634	3.069	3.479	3.880	4.280	2.874	3.159	3.449	3.725	4.005	4.288	4.578	12.082	10.245	9.131	8.302	7.674	7.132	6.657
50	294	4.14	13.414	11.260	9.951	8.990	8.207	7.543	6.962	1.550	2.164	2.640	3.071	3.481	3.881	4.279	4.251	4.235	4.305	4.418	4.557	4.714	4.890	10.712	9.189	8.286	7.642	7.131	6.709	6.352
51	300	4.14	13.403	11.301	9.971	9.004	8.204	7.547	6.966	1.557	2.159	2.637	3.070	3.480	3.878	4.279	5.947	5.547	5.355	5.269	5.231	5.237	5.274	9.013	7.913	7.253	6.805	6.453	6.187	5.970
52	306	4.14	13.429	11.293	9.984	9.024	8.225	7.561	6.982	1.567	2.152	2.631	3.074	3.488	3.893	4.284	7.809	6.961	6.500	6.205	5.980	5.823	5.704	7.188	6.483	6.115	5.893	5.732	5.631	5.563
53	312	4.14	13.407	11.285	9.974	9.024	8.233	7.570	6.992	1.567	2.164	2.651	3.076	3.485	3.883	4.276	9.609	8.359	7.625	7.116	6.710	6.387	6.121	5.365	5.091	5.000	4.985	5.008	5.066	5.148
54	318	4.14	13.381	11.274	9.974	9.005	8.241	7.579	6.989	1.570	2.168	2.651	3.083	3.495	3.889	4.283	11.192	9.586	8.616	7.907	7.362	6.895	6.488	3.759	3.856	4.008	4.180	4.375	4.573	4.785
55	324	4.14	13.394	11.260	9.979	9.013	8.236	7.572	6.987	1.568	2.170	2.654	3.086	3.498	3.901	4.293	12.440	10.527	9.388	8.535	7.854	7.276	6.770	2.522	2.903	3.245	3.564	3.880	4.197	4.510
56	330	4.14	13.406	11.264	9.968	9.008	8.224	7.567	6.995	1.575	2.162	2.645	3.084	3.496	3.895	4.284	13.205	11.109	9.843	8.907	8.144	7.504	6.949	1.777	2.317	2.770	3.185	3.577	3.958	4.330
57	336	4.14	13.446	11.301	9.974	9.030	8.244	7.587	6.998	1.581	2.170	2.649	3.090	3.492	3.896	4.295	13.438	11.294	9.969	9.026	8.241	7.585	6.996	1.589	2.177	2.654	3.094	3.496	3.898	4.297
58	342	4.14	13.457	11.319	10.002	9.038	8.249	7.586	6.996	1.570	2.172	2.657	3.083	3.493	3.898	4.291	13.062	11.016	9.758	8.840	8.091	7.463	6.906	1.964	2.475	2.901	3.280	3.651	4.021	4.381
59	348	4.14	13.455	11.318	9.996	9.033	8.246	7.585	6.992	1.567	2.168	2.651	3.079	3.488	3.886	4.283	12.130	10.298	9.177	8.369	7.716	7.173	6.690	2.892	3.187	3.470	3.742	4.018	4.299	4.585
60	354	4.14	13.520	11.339	10.003	9.040	8.252	7.585	6.994	1.570	2.169	2.653	3.075	3.490	3.894	4.291	10.799	9.251	8.329	7.682	7.168	6.745	6.378	4.291	4.257	4.327	4.433	4.574	4.734	4.906
61	360	4.14	13.485	11.363	10.017	9.044	8.251	7.596	7.016	1.576	2.166	2.640	3.079	3.495	3.899	4.297	9.072	7.954	7.283	6.833	6.488	6.226	6.008	5.990	5.574	5.373	5.290	5.257	5.269	5.305

A.8 Appendix: The LIBOR interest rate stress curve

Libor Interest Rate Stress Curve Generator: output S&P. All numbers indicate the % of Libor in the respective period

Payment Periods per Year

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Period	Month start	FWD	AAA UP	AA UP	A UP	BBB UP	BB UP	B UP	CCC UP	AAA DOWN	AA DOWN	A DOWN	BBB DOWN	BB DOWN	B DOWN	CCC DOWN	AAA DOWN /UP	AA DOWN /UP	A DOWN /UP	BBB DOWN /UP	BB DOWN /UP	B DOWN /UP	CCC DOWN /UP	AAA UP /DOWN	AA UP /DOWN	A UP /DOWN	BBB UP /DOWN	BB UP /DOWN	B UP /DOWN	CCC UP /DOWN
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	6	4.86	5.77	5.51	5.34	5.20	5.08	4.98	4.88	3.45	3.70	3.88	4.01	4.13	4.24	4.33	4.55	4.56	4.57	4.58	4.58	4.59	4.59	4.67	4.66	4.65	4.64	4.63	4.63	4.62
3	12	5.25	7.78	7.00	6.51	6.12	5.81	5.53	5.27	2.19	2.66	2.99	3.26	3.52	3.74	3.96	3.98	4.05	4.12	4.18	4.25	4.32	4.38	5.99	5.61	5.38	5.21	5.07	4.95	4.85
4	18	5.02	8.58	7.56	6.91	6.41	6.01	5.66	5.34	1.75	2.24	2.61	2.92	3.21	3.48	3.74	3.01	3.23	3.41	3.57	3.73	3.88	4.03	7.31	6.57	6.12	5.77	5.49	5.26	5.04
5	24	5.20	9.94	8.65	7.85	7.24	6.73	6.29	5.90	1.68	2.22	2.65	3.01	3.35	3.66	3.96	2.35	2.74	3.07	3.35	3.62	3.88	4.12	9.28	8.13	7.43	6.90	6.46	6.08	5.74
6	30	5.15	10.77	9.30	8.39	7.69	7.12	6.62	6.17	1.62	2.19	2.63	3.01	3.36	3.70	4.03	1.78	2.31	2.72	3.09	3.43	3.75	4.07	10.62	9.18	8.29	7.61	7.05	6.57	6.14
7	36	5.18	11.50	9.87	8.86	8.10	7.47	6.91	6.44	1.62	2.20	2.66	3.06	3.43	3.79	4.14	1.62	2.20	2.66	3.06	3.43	3.79	4.14	11.50	9.87	8.86	8.10	7.46	6.91	6.44
8	42	5.10	11.85	10.14	9.05	8.24	7.60	7.03	6.53	1.59	2.17	2.63	3.04	3.41	3.78	4.14	1.93	2.43	2.84	3.21	3.55	3.89	4.22	11.51	9.87	8.83	8.07	7.46	6.93	6.45
9	48	5.10	12.33	10.52	9.38	8.53	7.85	7.26	6.73	1.59	2.18	2.65	3.07	3.48	3.86	4.23	2.79	3.11	3.40	3.68	3.96	4.24	4.50	11.14	9.59	8.63	7.92	7.36	6.88	6.45
10	54	5.02	12.61	10.72	9.55	8.66	7.94	7.33	6.79	1.59	2.18	2.66	3.08	3.48	3.86	4.24	4.10	4.13	4.23	4.35	4.49	4.65	4.82	10.10	8.78	7.98	7.39	6.92	6.54	6.21
11	60	5.00	12.89	10.95	9.74	8.82	8.09	7.46	6.91	1.60	2.20	2.68	3.11	3.52	3.91	4.30	5.79	5.44	5.30	5.23	5.21	5.23	5.27	8.71	7.71	7.13	6.70	6.39	6.15	5.94
12	66	4.98	13.19	11.18	9.93	8.99	8.23	7.60	7.03	1.61	2.23	2.72	3.15	3.57	3.97	4.36	7.70	6.94	6.51	6.23	6.02	5.88	5.76	7.10	6.47	6.13	5.92	5.77	5.69	5.63
13	72	4.96	13.39	11.32	10.06	9.11	8.35	7.69	7.12	1.63	2.24	2.73	3.17	3.59	4.00	4.41	9.61	8.41	7.71	7.20	6.82	6.51	6.25	5.40	5.15	5.08	5.08	5.12	5.19	5.28
14	78	4.92	13.67	11.61	10.27	9.30	8.50	7.82	7.24	1.63	2.26	2.77	3.23	3.66	4.07	4.48	11.44	9.87	8.88	8.17	7.60	7.13	6.73	3.87	3.99	4.16	4.35	4.56	4.77	4.99
15	84	4.90	13.65	11.52	10.22	9.26	8.47	7.79	7.20	1.61	2.24	2.73	3.19	3.61	4.03	4.44	12.68	10.77	9.62	8.77	8.07	7.48	6.97	2.58	2.99	3.34	3.68	4.00	4.33	4.66
16	90	4.90	13.56	11.45	10.15	9.18	8.41	7.75	7.15	1.61	2.23	2.72	3.16	3.58	3.99	4.40	13.36	11.29	10.03	9.08	8.33	7.68	7.11	1.81	2.38	2.84	3.27	3.66	4.06	4.45
17	96	4.88	13.61	11.47	10.14	9.17	8.40	7.73	7.14	1.61	2.22	2.71	3.16	3.58	3.99	4.40	13.60	11.47	10.13	9.17	8.39	7.73	7.14	1.62	2.22	2.72	3.16	3.58	4.00	4.40
18	102	4.80	13.57	11.42	10.10	9.12	8.33	7.67	7.08	1.60	2.20	2.69	3.13	3.55	3.96	4.37	13.17	11.11	9.85	8.92	8.17	7.55	6.99	2.00	2.50	2.94	3.33	3.71	4.09	4.46
19	108	4.77	13.53	11.42	10.07	9.11	8.33	7.66	7.06	1.58	2.19	2.68	3.13	3.55	3.95	4.35	12.20	10.39	9.25	8.44	7.80	7.24	6.76	2.91	3.22	3.50	3.79	4.08	4.36	4.65
20	114	4.71	13.51	11.37	10.04	9.07	8.30	7.64	7.05	1.58	2.18	2.67	3.12	3.53	3.94	4.34	10.79	9.27	8.37	7.71	7.21	6.80	6.44	4.29	4.27	4.35	4.47	4.62	4.78	4.96
21	120	4.68	13.41	11.30	10.00	9.02	8.24	7.58	7.00	1.58	2.17	2.66	3.09	3.50	3.91	4.30	9.02	7.92	7.28	6.82	6.48	6.22	6.00	5.96	5.56	5.38	5.29	5.26	5.27	5.30
22	126	4.60	13.22	11.16	9.86	8.91	8.15	7.49	6.91	1.56	2.16	2.63	3.06	3.46	3.85	4.25	7.09	6.42	6.06	5.83	5.68	5.57	5.51	7.70	6.89	6.44	6.14	5.93	5.76	5.65
23	132	4.56	13.24	11.17	9.87	8.93	8.15	7.50	6.92	1.55	2.14	2.62	3.05	3.46	3.85	4.25	5.30	5.04	4.95	4.94	4.96	5.02	5.10	9.49	8.28	7.54	7.04	6.64	6.33	6.06
24	138	4.58	13.61	11.46	10.14	9.16	8.37	7.69	7.10	1.59	2.19	2.68	3.12	3.54	3.94	4.35	3.82	3.91	4.06	4.24	4.43	4.64	4.86	11.39	9.74	8.76	8.04	7.48	7.00	6.59
25	144	4.55	13.39	11.26	9.95	8.98	8.21	7.54	6.96	1.56	2.14	2.63	3.06	3.47	3.86	4.25	2.51	2.88	3.22	3.53	3.85	4.16	4.47	12.43	10.52	9.36	8.50	7.82	7.24	6.74
26	150	4.55	13.21	11.11	9.83	8.86	8.10	7.45	6.87	1.53	2.13	2.61	3.03	3.43	3.82	4.21	1.73	2.28	2.73	3.12	3.51	3.88	4.26	13.01	10.96	9.71	8.76	8.02	7.38	6.82
27	156	4.52	13.14	11.06	9.77	8.83	8.06	7.40	6.83	1.53	2.12	2.58	3.00	3.39	3.78	4.18	1.54	2.12	2.59	3.01	3.40	3.78	4.18	13.13	11.05	9.76	8.83	8.06	7.40	6.82
28	162	4.45	13.15	11.10	9.80	8.84	8.08	7.43	6.86	1.54	2.11	2.58	3.01	3.42	3.80	4.19	1.92	2.41	2.82	3.20	3.57	3.92	4.28	12.77	10.80	9.56	8.65	7.92	7.31	6.77
29	168	4.41	12.97	10.96	9.68	8.73	7.97	7.33	6.75	1.51	2.09	2.56	2.97	3.37	3.75	4.13	2.79	3.07	3.35	3.62	3.88	4.15	4.42	11.69	9.97	8.89	8.09	7.46	6.93	6.46
30	174	4.45	13.18	11.11	9.82	8.85	8.08	7.42	6.85	1.53	2.12	2.59	3.02	3.43	3.82	4.21	4.18	4.16	4.23	4.35	4.49	4.64	4.81	10.53	9.06	8.17	7.53	7.02	6.60	6.25
31	180	4.42	13.10	11.02	9.74	8.79	8.01	7.36	6.79	1.52	2.10	2.56	2.99	3.39	3.77	4.16	5.81	5.40	5.22	5.14	5.10	5.10	5.13	8.81	7.71	7.08	6.64	6.30	6.03	5.81
32	186	4.50	13.58	11.38	10.04	9.07	8.28	7.61	7.02	1.57	2.16	2.65	3.08	3.48	3.88	4.28	7.89	7.01	6.54	6.23	6.00	5.84	5.72	7.26	6.53	6.15	5.92	5.75	5.65	5.58
33	192	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
34	198	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
35	204	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
36	210	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
37	216	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
38	222	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
39	228	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
40	234	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
41	240	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
42	246	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
43	252	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
44	258	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
45	264	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
46	270	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
47	276	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
48	282	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
49	288	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
50	294	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
51	300	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
52	306	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
53	312	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
54	318	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
55	324	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
56	330	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
57	336	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
58	342	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
59	348	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
60	354	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13
61	360	4.48	13.50	11.32	9.99	9.02	8.24	7.56	6.97	1.56	2.15	2.63	3.06	3.47	3.87	4.26	9.67	8.38	7.63	7.11	6.71	6.38	6.10	5.39	5.09	4.99	4.97	5.00	5.05	5.13

A.9 Appendix: The FX-rate stress curve

FX-Rate Stress Curve Generator: output S&P
Payment Periods per Year 2.000

Period	Month start	FWD	AAA UP	AA UP	A UP	BBB UP	BB UP	B UP	CCC UP	AAA DOWN	AA DOWN	A DOWN	BBB DOWN	BB DOWN	B DOWN	CCC DOWN
1	0	1.463	1.538	1.538	1.538	1.538	1.538	1.538	1.000	1.550	1.550	1.550	1.550	1.550	1.550	1.000
2	6	1.452	2.024	1.947	1.876	1.768	1.672	1.619	1.000	1.240	1.240	1.240	1.240	1.240	1.240	1.000
3	12	1.443	1.947	1.923	1.899	1.832	1.768	1.709	1.000	0.388	0.388	0.388	0.388	0.388	0.388	1.000
4	18	1.434	2.198	2.137	2.079	1.947	1.832	1.748	1.000	0.667	0.667	0.667	0.667	0.667	0.667	1.000
5	24	1.425	2.137	2.079	2.051	1.923	1.832	1.748	1.000	0.682	0.682	0.682	0.682	0.682	0.682	1.000
6	30	1.417	2.653	2.442	2.296	2.024	1.854	1.748	1.000	1.116	1.116	1.116	1.116	1.116	1.116	1.000
7	36	1.409	4.662	3.273	2.747	2.137	1.876	1.748	1.000	1.163	1.163	1.163	1.163	1.163	1.163	1.000
8	42	1.402	5.698	3.663	2.959	2.230	1.923	1.768	1.000	1.132	1.132	1.132	1.132	1.132	1.132	1.000
9	48	1.395	6.154	3.663	2.903	2.198	1.899	1.768	1.000	1.194	1.194	1.194	1.194	1.194	1.194	1.000
10	54	1.389	10.256	3.945	2.959	2.107	1.854	1.729	1.000	1.287	1.287	1.287	1.287	1.287	1.287	1.000
11	60	1.384	15.385	4.396	3.077	2.167	1.876	1.729	1.000	1.271	1.271	1.271	1.271	1.271	1.271	1.000
12	66	1.374	3.663	2.959	2.653	2.167	1.923	1.789	1.000	1.101	1.101	1.101	1.101	1.101	1.101	1.000
13	72	1.365	2.522	2.404	2.296	2.079	1.923	1.832	1.000	0.837	0.837	0.837	0.837	0.837	0.837	1.000
14	78	1.362	2.296	2.262	2.198	2.079	1.947	1.854	1.000	0.558	0.558	0.558	0.558	0.558	0.558	1.000
15	84	1.359	2.653	2.522	2.404	2.167	1.998	1.876	1.000	1.054	1.054	1.054	1.054	1.054	1.054	1.000
16	90	1.357	15.385	15.385	13.986	2.608	1.972	1.768	1.000	1.302	1.302	1.302	1.302	1.302	1.302	1.000
17	96	1.356	4.963	3.663	3.140	2.404	2.051	1.899	1.000	1.132	1.132	1.132	1.132	1.132	1.132	1.000
18	102	1.355	4.396	3.497	3.077	2.404	2.107	1.947	1.000	1.116	1.116	1.116	1.116	1.116	1.116	1.000
19	108	1.355	5.698	3.945	3.273	2.481	2.137	1.972	1.000	1.256	1.256	1.256	1.256	1.256	1.256	1.000
20	114	1.366	15.385	9.050	4.963	2.849	2.262	2.051	1.000	1.318	1.318	1.318	1.318	1.318	1.318	1.000
21	120	1.377	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
22	126	1.382	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
23	132	1.388	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
24	138	1.393	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
25	144	1.399	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
26	150	1.404	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
27	156	1.410	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
28	162	1.415	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
29	168	1.421	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
30	174	1.426	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
31	180	1.432	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
32	186	1.438	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
33	192	1.445	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
34	198	1.452	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
35	204	1.458	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
36	210	1.465	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
37	216	1.471	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
38	222	1.478	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
39	228	1.484	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
40	234	1.491	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
41	240	1.497	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
42	246	1.500	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
43	252	1.503	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
44	258	1.506	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
45	264	1.509	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
46	270	1.512	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
47	276	1.515	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
48	282	1.519	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
49	288	1.522	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
50	294	1.525	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
51	300	1.528	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
52	306	1.531	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
53	312	1.534	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
54	318	1.537	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
55	324	1.540	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
56	330	1.543	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
57	336	1.546	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
58	342	1.549	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
59	348	1.552	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
60	354	1.555	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000
61	360	1.558	15.385	5.698	3.752	2.481	2.137	1.972	1.000	1.504	1.504	1.504	1.504	1.504	1.504	1.000

A.10 Appendix: The S&P default rate table

		R A T I N G																		
		AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCC	CCC-
	1	0.000	0.002	0.013	0.024	0.027	0.033	0.049	0.234	0.353	0.967	1.632	2.525	3.803	4.510	5.824	8.138	23.582	45.560	66.413
	2	0.009	0.017	0.062	0.078	0.097	0.121	0.185	0.514	0.825	2.142	3.211	4.946	7.260	8.885	11.751	16.674	38.104	59.145	79.233
	3	0.030	0.050	0.135	0.166	0.212	0.263	0.396	0.850	1.405	3.415	4.758	7.230	10.401	12.960	17.152	24.004	46.752	64.835	82.905
	4	0.065	0.104	0.232	0.290	0.372	0.459	0.676	1.246	2.073	4.728	6.276	9.380	13.265	16.694	21.921	30.025	52.288	68.078	84.581
	5	0.118	0.182	0.356	0.452	0.578	0.709	1.020	1.704	2.812	6.046	7.763	11.403	15.886	20.087	26.089	34.945	56.158	70.313	85.650
	6	0.190	0.287	0.512	0.654	0.830	1.013	1.424	2.221	3.607	7.352	9.216	13.310	18.291	23.156	29.725	38.996	59.071	72.019	86.454
	7	0.285	0.420	0.701	0.897	1.128	1.368	1.883	2.792	4.443	8.635	10.632	15.110	20.503	25.929	32.903	42.374	61.383	73.396	87.105
	8	0.405	0.584	0.927	1.182	1.472	1.774	2.395	3.413	5.310	9.891	12.007	16.810	22.544	28.435	35.692	45.227	63.284	74.546	87.653
	9	0.552	0.781	1.191	1.509	1.859	2.226	2.954	4.076	6.198	11.116	13.340	18.418	24.432	30.702	38.151	47.666	64.886	75.529	88.124
	10	0.728	1.013	1.493	1.876	2.290	2.724	3.557	4.777	7.103	12.309	14.631	19.941	26.182	32.760	40.331	49.776	66.261	76.383	88.535
Y	11	0.934	1.280	1.833	2.285	2.762	3.263	4.198	5.510	8.017	13.471	15.881	21.386	27.809	34.633	42.275	51.620	67.459	77.133	88.899
E	12	1.173	1.583	2.213	2.733	3.273	3.841	4.873	6.269	8.937	14.602	17.091	22.758	29.326	36.343	44.018	53.245	68.512	77.799	89.223
A	13	1.445	1.923	2.631	3.219	3.822	4.454	5.578	7.050	9.860	15.704	18.261	24.064	30.744	37.910	45.589	54.691	69.448	78.396	89.515
R	14	1.750	2.300	3.086	3.742	4.404	5.099	6.309	7.850	10.783	16.776	19.394	25.307	32.073	39.353	47.014	55.985	70.287	78.935	89.779
	15	2.089	2.712	3.577	4.299	5.018	5.773	7.063	8.664	11.704	17.822	20.491	26.494	33.323	40.685	48.313	57.154	71.045	79.426	90.020

A.11 Appendix: Results of the cash flow simulation

In chapter 6 the 8 test-structures were exposed to the rating scenarios used by the rating agencies to assess whether the structures are able to endure the minimal required default rate, the SDR. The initial test, used to evaluate whether the different structures were able to cope with the interest rate mismatch, proved that none of the 8 test structures met these minimum requirements. In other words, the stress caused by the interest mismatches resulting from defaults among the foreign assets proved to be too severe for the structures created in this part of research. The results from this initial test are shown in the table below, table A11-1

Table A11-1: Results of the initial stress test

Structures	Spread in BP	Ranking VFN (Senior/Pari-passu)	Payment allocation (Like-for-like/Pro-rata)	Redenomination (Yes/No)	Break even Default Rate (5% percentile)	BDR >= Base Case (Pass/Fail)
Base case structure		n/a	Pro-rata	n/a	60.00%	n/a
structure 1	284	Senior	Like-for-like	Yes	46,01%	Fail
structure 2	284	Senior	Like-for-like	No	45,51%	Fail
structure 3	284	Senior	Pro-rata	Yes	39,28%	Fail
structure 4	284	Senior	Pro-rata	No	38,90%	Fail
structure 5	284	Pari-passu	Like-for-like	Yes	57,62%	Fail
structure 6	284	Pari-passu	Like-for-like	No	55,48%	Fail
structure 7	284	Pari-passu	Pro-rata	Yes	39,08%	Fail
structure 8	284	Pari-passu	Pro-rata	No	38,70%	Fail

Even though the test-structures fail to meet the SDR levels, analysis of the results does provide some interesting insight regarding the test-structures sensitivity to different stress factors. By immunising the structures to these sensitivities their BDRs would increase potentially to a level at which they meet the SDRs.

To determine the weak points of the test-structures their behaviour under different stress scenarios is analysed in a pair-wise comparison. Structures which share 2 of the 3 structural features (e.g. the ranking of the VFN, payment allocation and ability to redenominate) will be compared at a time. As such the difference in the BDRs found in these pair-wise comparisons can be attributed to the structural feature that differs. This will provide a qualitative measure for the relationship between the rating parameters and the structural features of the test-structures.

Ranking of VFN

To evaluate the influence of the ranking of the VFN, the performance of the four test-structures including a senior ranking VFN was compared to the performance of the other four structures including a pari-passu ranking VFN. More specifically, for each rating scenario the difference between the BDR obtained by the structure including a pari-passu ranking VFN and the structure including a senior ranking VFN was calculated by subtracting the prior from the latter. The histograms of the resulting distributions are included on the next page. In addition a summary of this comparison is included in the table below, table A11-2.

Table A11-2: Summary of pair wise comparison with regards to the VFN

Ranking VFN	SLY-PLY	SLN-PLN	SPY-PPY	SPN-PPN
Number of changes	585.00	585.00	583.00	585.00
Average change	-12.51%	-12.34%	0.75%	1.11%
Standard deviation[32]	0.1416	0.14748	0.03629	0.03601
Skewness[33]	0.4226	0.42968	4.12522	4.01655
Kurtosis[34]	-1.5114	-1.5601	26.8201	26.0554

The summary provided in the table above indicates that a senior ranked VFN is beneficial to a structure using a pro-rata payment allocation. The histograms for the SPY-PPY and SPN-PPN show a nice bell shaped curve which is slightly skewed to the left. The distribution of the differences is highly leptokurtic; meaning that it has a higher probability than a normally distributed variable at extreme values.

A different picture emerges when the differences between the SLY-PLY and SLN-PLN pairs are observed. From the summary it seems that a pari-passu ranked VFN performs better when a like-for-like payment structure is used. The mean average BDR for the structures including a pari-passu ranking VFN is more than 12% higher relative to the structures with a senior VFN. In addition when a like-for-like payment allocation is used the resulting BDRs have a rather large standard deviation, indicating a greater ambiguity among results that were obtained by running different scenarios. This ambiguity is easily spotted in the histograms in the form of the two different peaks in the distribution of the data. On some scenarios the structures including a senior ranked VFN evidently were able to sustain a higher default rate, while in most structures the BDR was lower. This is shown in the table above by the small positive skew and the larger negative average. The negative kurtosis for these structures further indicates that the distribution has a lower, wider peak around the mean (that is, a lower probability than a normally distributed variable of values near the mean) and thinner tails (if viewed as the height of the probability density—that is, a lower probability than a normally distributed variable of extreme values).

[32] The standard deviation is defined as:

$$\sqrt{\frac{\sum (x-\bar{x})^2}{(n-1)}}$$

[33] The skewness is defined as:

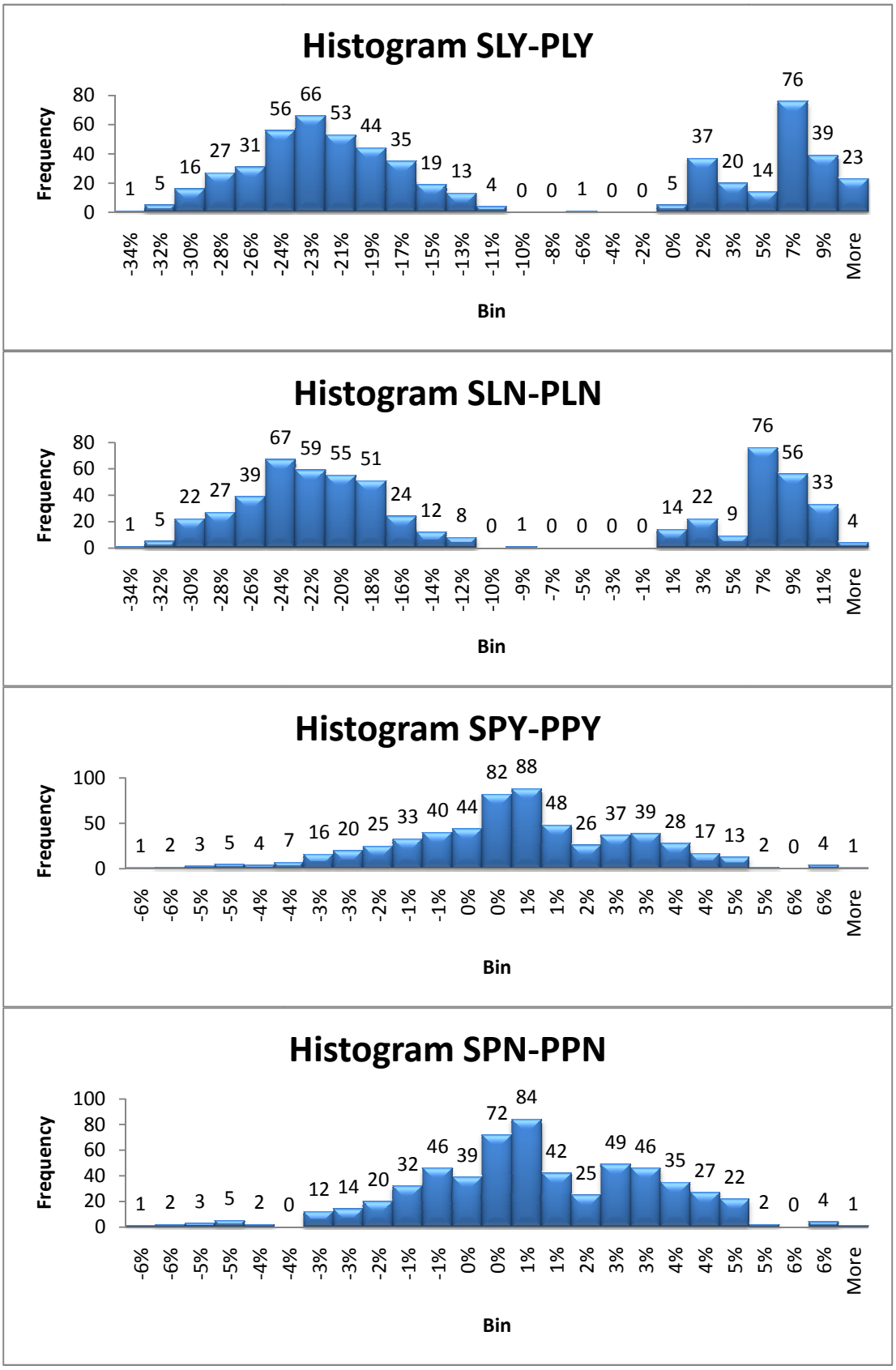
$$\frac{n}{(n-1)(n-2)}\sum\left(\frac{x_i-\bar{x}}{s}\right)^3,$$

where s is the sample standard deviation as per the definition provided above.

[34] The Kurtosis is defined as:

$$\left\{\frac{n(n+1)}{(n-1)(n-2)(n-3)}\sum\left(\frac{x_i-\bar{x}}{s}\right)^4\right\} - \frac{3(n-1)^2}{(n-2)(n-3)},$$

where s is the sample standard deviation as per the definition provided above.


Histogram SLY-PLY
Frequency
Bin
1 5 16 27 31 56 66 53 44 35 19 13 4 0 0 1 0 0 5 37 20 14 76 39 23
-34% -32% -30% -28% -26% -24% -23% -21% -19% -17% -15% -13% -11% -10% -8% -6% -4% -2% 0% 2% 3% 5% 7% 9% More
Histogram SLN-PLN
Frequency
Bin
1 5 22 27 39 67 59 55 51 24 12 8 0 1 0 0 0 0 14 22 9 76 56 33 4
-34% -32% -30% -28% -26% -24% -22% -20% -18% -16% -14% -12% -10% -9% -7% -5% -3% -1% 1% 3% 5% 7% 9% 11% More
Histogram SPY-PPY
Frequency
Bin
1 2 3 5 4 7 16 20 25 33 40 44 82 88 48 26 37 39 28 17 13 2 0 4 1
-6% -6% -5% -5% -4% -4% -3% -3% -2% -1% -1% 0% 0% 1% 1% 2% 3% 3% 4% 4% 5% 5% 6% 6% More
Histogram SPN-PPN
Frequency
Bin
1 2 3 5 2 0 12 14 20 32 46 39 72 84 42 25 49 46 35 27 22 2 0 4 1
-6% -6% -5% -5% -4% -4% -3% -3% -2% -1% -1% 0% 0% 1% 1% 2% 3% 3% 4% 4% 5% 5% 6% 6% More

To determine which rating parameters contributed to the results shown in the summary the performance of the test structures was pair-wise compared on the 585 selected rating scenarios. Each of the tables below is related to one of the rating parameters used by S&P: Euribor index, Libor index, FX index, default timing and default pattern.
The top row in these tables indicates which structures are being pair-wise compared. The values in the table indicate the number of times the specific parameter was included in the rating scenarios which resulted in a different BDR for the compared structured. The tables will make a distinction between those scenarios for which a senior ranking VFN is an improvement, on the right, and those scenarios for which a pari-passu ranking resulted in higher BDR, on the left. Below each of these tables, a short conclusion is formulated.

Default timing	SLY<PLY	SLN<PLN	SPY<PPY	SPN<PPN	Default timing	SLY>PLY	SLN>PLN	SPY>PPY	SPN>PPN
1	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00
2	1.00	0.00	1.00	1.00	2	1.00	2.00	1.00	1.00
3	6.00	0.00	6.00	5.00	3	4.00	10.00	2.00	5.00
4	2.00	0.00	2.00	5.00	4	14.00	16.00	14.00	11.00
5	0.00	0.00	5.00	3.00	5	19.00	19.00	14.00	16.00
6	71.00	71.00	40.00	15.00	6	15.00	15.00	46.00	71.00
7	100.00	100.00	32.00	32.00	7	24.00	24.00	92.00	92.00
8	100.00	100.00	62.00	62.00	8	49.00	49.00	87.00	87.00
9	104.00	104.00	76.00	76.00	9	75.00	75.00	103.00	103.00

When the default pattern is started during the first 5 years of the transaction, the transactions including a senior ranked VFN perform better than those with a pari-passu ranking VFN. When the default pattern is started in year 6 or later, this seems to reverse. Apparently delaying the default timing favours a pari-passu ranking VFN when a like-for-like payment allocation is used, while a senior ranking VFN is slightly favoured when a pro-rata payment allocation is used.

EURIBOR	SLY<PLY	SLN<PLN	SPY<PPY	SPN<PPN	EURIBOR	SLY>PLY	SLN>PLN	SPY>PPY	SPN>PPN
FWD	74.00	74.00	18.00	13.00	FWD	31.00	31.00	87.00	92.00
AAA UP	85.00	76.00	90.00	85.00	AAA UP	74.00	83.00	67.00	74.00
AAA Down	74.00	74.00	33.00	32.00	AAA Down	11.00	11.00	52.00	53.00
AAA UP/down	76.00	76.00	64.00	52.00	AAA UP/down	41.00	41.00	53.00	65.00
AAA down/UP	75.00	75.00	19.00	17.00	AAA down/UP	44.00	44.00	100.00	102.00

The slope of the EURIBOR index provides a diverse and somewhat ambiguous picture. The structures using a senior VFN and a like-for-like payment allocation evidently suffer from a forward or downward moving EURIBOR index, whilst the structures applying a pro-rata payment allocation seem to benefit from such a slope.

LIBOR	SLY<PLY	SLN<PLN	SPY<PPY	SPN<PPN	LIBOR	SLY>PLY	SLN>PLN	SPY>PPY	SPN>PPN
FWD	75.00	75.00	51.00	45.00	FWD	12.00	12.00	36.00	42.00
AAA UP	78.00	75.00	32.00	25.00	AAA UP	120.00	123.00	164.00	173.00
AAA Down	72.00	71.00	46.00	42.00	AAA Down	0.00	1.00	26.00	30.00
AAA UP/down	76.00	75.00	35.00	32.00	AAA UP/down	38.00	39.00	79.00	82.00
AAA down/UP	83.00	79.00	60.00	55.00	AAA down/UP	31.00	35.00	54.00	59.00

The results above clearly show that an increasing LIBOR index is beneficial to structures including a senior ranking VFN, while a downwards slope is favourable for a structure including a pari-passu ranking VFN.

FX	SLY<PLY	SLN<PLN	SPY<PPY	SPN<PPN	FX	SLY>PLY	SLN>PLN	SPY>PPY	SPN>PPN
FWD	8.00	2.00	23.00	26.00	FWD	98.00	104.00	81.00	80.00
AAA UP	371.00	371.00	180.00	156.00	AAA UP	0.00	0.00	191.00	215.00
AAA Down	5.00	2.00	21.00	17.00	AAA Down	103.00	106.00	87.00	91.00

Maybe somewhat at odds with expectations the direction of the FX index shows distinctive results. It should be emphasised that the FX options used in the structures only provides a hedge against an appreciating Pound. The options used in the hedging strategy provide a ceiling to the price at which Euros can be converted into Pounds. Nevertheless a conversion form Pounds to Euros still occurs at spot.
When a forward and downwards sloping FX index is applied, the structures with a senior ranking VFN perform better. Interestingly, under an upwards moving FX-index better results are obtained by pari-passu ranking structures with like-for-like cash flow allocation and mixed results otherwise.

Default pattern	SLY<PLY	SLN<PLN	SPY<PPY	SPN<PPN	Default pattern	SLY>PLY	SLN>PLN	SPY>PPY	SPN>PPN
15/30/30/15/10	104.00	100.00	68.00	63.00	15/30/30/15/10	82.00	86.00	117.00	123.00
20/20/20/20/20	100.00	100.00	54.00	42.00	20/20/20/20/20	25.00	25.00	71.00	83.00
25/25/25/25	104.00	100.00	68.00	61.00	25/25/25/25	63.00	67.00	98.00	106.00
40/20/20/10/10	76.00	75.00	34.00	33.00	40/20/20/10/10	31.00	32.00	73.00	74.00

The table related to the default patterns shows mixed results with regards to the performance of a senior or pari-passu ranking VFN. When a senior ranking VFN is combined with a like-for-like payment allocation, the maximum default rate the transaction can sustain is in most situations lower than when the VFN ranks pari-passu. Interestingly the reverse is true for a pro-rata payment allocation.

Interest Indices (EURIBOR&LIBOR)	SLY <PLY	SLN <PLN	SPY <PPY	SPN <PPN	Interest Indices (EURIBOR&LIBOR)	SLY >PLY	SLN >PLN	SPY >PPY	SPN >PPN
FWD & FWD	15.00	15.00	6.00	4.00	FWD & FWD	0.00	0.00	9.00	11.00
FWD & AAA UP	15.00	15.00	2.00	2.00	FWD & AAA UP	23.00	23.00	36.00	36.00
FWD & AAA Down	14.00	14.00	5.00	3.00	FWD & AAA Down	0.00	0.00	9.00	11.00
FWD & AAA UP/down	15.00	15.00	2.00	2.00	FWD & AAA UP/down	8.00	8.00	21.00	21.00
FWD & AAA down/UP	15.00	15.00	3.00	2.00	FWD & AAA down/UP	0.00	0.00	12.00	13.00
AAA UP & FWD	15.00	15.00	18.00	18.00	AAA UP & FWD	8.00	8.00	5.00	5.00
AAA UP & AAA UP	18.00	15.00	16.00	12.00	AAA UP & AAA UP	38.00	41.00	38.00	44.00
AAA UP & AAA Down	15.00	14.00	15.00	14.00	AAA UP &AAA Down	0.00	1.00	0.00	1.00
AAA UP & AAA UP/down	16.00	15.00	15.00	15.00	AAA UP & AAA UP/down	12.00	13.00	13.00	13.00
AAA UP & AAA down/UP	21.00	17.00	26.00	26.00	AAA UP & AAA down/UP	16.00	20.00	11.00	11.00
AAA Down & FWD	15.00	15.00	7.00	7.00	AAA Down & FWD	0.00	0.00	8.00	8.00
AAA Down & AAA UP	15.00	15.00	3.00	3.00	AAA Down & AAA UP	9.00	9.00	21.00	21.00
AAA Down & AAA Down	14.00	14.00	9.00	9.00	AAA Down & AAA Down	0.00	0.00	5.00	5.00
AAA Down & AAA UP/down	15.00	15.00	4.00	4.00	AAA Down & AAA UP/down	2.00	2.00	13.00	13.00
AAA Down & AAA down/UP	15.00	15.00	10.00	9.00	AAA Down & AAA down/UP	0.00	0.00	5.00	6.00
AAA UP/down & FWD	15.00	15.00	16.00	13.00	AAA UP/down & FWD	4.00	4.00	3.00	6.00
AAA UP/down & AAA UP	15.00	15.00	8.00	5.00	AAA UP/down & AAA UP	20.00	20.00	27.00	30.00
AAA UP/down & AAA Down	14.00	14.00	12.00	12.00	AAA UP/down& AAA Down	0.00	0.00	2.00	2.00
AAA UP/down & AAA UP/down	15.00	15.00	10.00	7.00	AAA UP/down & AAA UP/down	13.00	13.00	18.00	21.00
AAA UP/down & AAA down/UP	17.00	17.00	18.00	15.00	AAA UP/down & AAA down/UP	4.00	4.00	3.00	6.00
AAA down/UP & FWD	15.00	15.00	4.00	3.00	AAA down/UP & FWD	0.00	0.00	11.00	12.00
AAA down/UP & AAA UP	15.00	15.00	3.00	3.00	AAA down/UP & AAA UP	30.00	30.00	42.00	42.00
AAA down/UP & AAA Down	15.00	15.00	5.00	4.00	AAA down/UP & AAA Down	0.00	0.00	10.00	11.00
AAA down/UP & AAA UP/down	15.00	15.00	4.00	4.00	AAA down/UP & AAA UP/down	3.00	3.00	14.00	14.00
AAA down/UP & AAA down/UP	15.00	15.00	3.00	3.00	AAA down/UP & AAA down/UP	11.00	11.00	23.00	23.00
Total	384.00	375.00	224.00	199.00	Total	201.00	210.00	359.00	386.00

Lastly, when a combination of interest indices is considered, it appears that a senior ranking VFN will allow a structure to achieve a higher BDR when the indices move in opposite directions: AAA up & AAA down and AAA down & AAA up. In addition, the table confirms the earlier conclusion that an upwards sloping LIBOR index is less stressful for structures using a senior ranked VFN.

Conclusion ranking VFN

In short it appears that a senior ranking VFN performs better when it is combined with a pro-rata payment allocation. The results shown by these structures appear to be more consistent. These structures seem most sensitive to a downwards sloping LIBOR index or a constant or depreciating Pound.

The results obtained by comparing SLY-PLY and SLN-PLN show ambiguous results. As indicated by the histogram, the distribution of the differences between the BDRs shows two distinct peaks. The analysis performed above found some clear sensitivities, mostly related to the slope of the EURIBOR and LIBOR curves, where the structures including a senior VFN clearly benefit from a downwards sloping or forward EURIBOR index and an upwards moving LIBOR index. Furthermore it was found that the performance of these structures declines in an environment with an appreciating Pound Sterling.

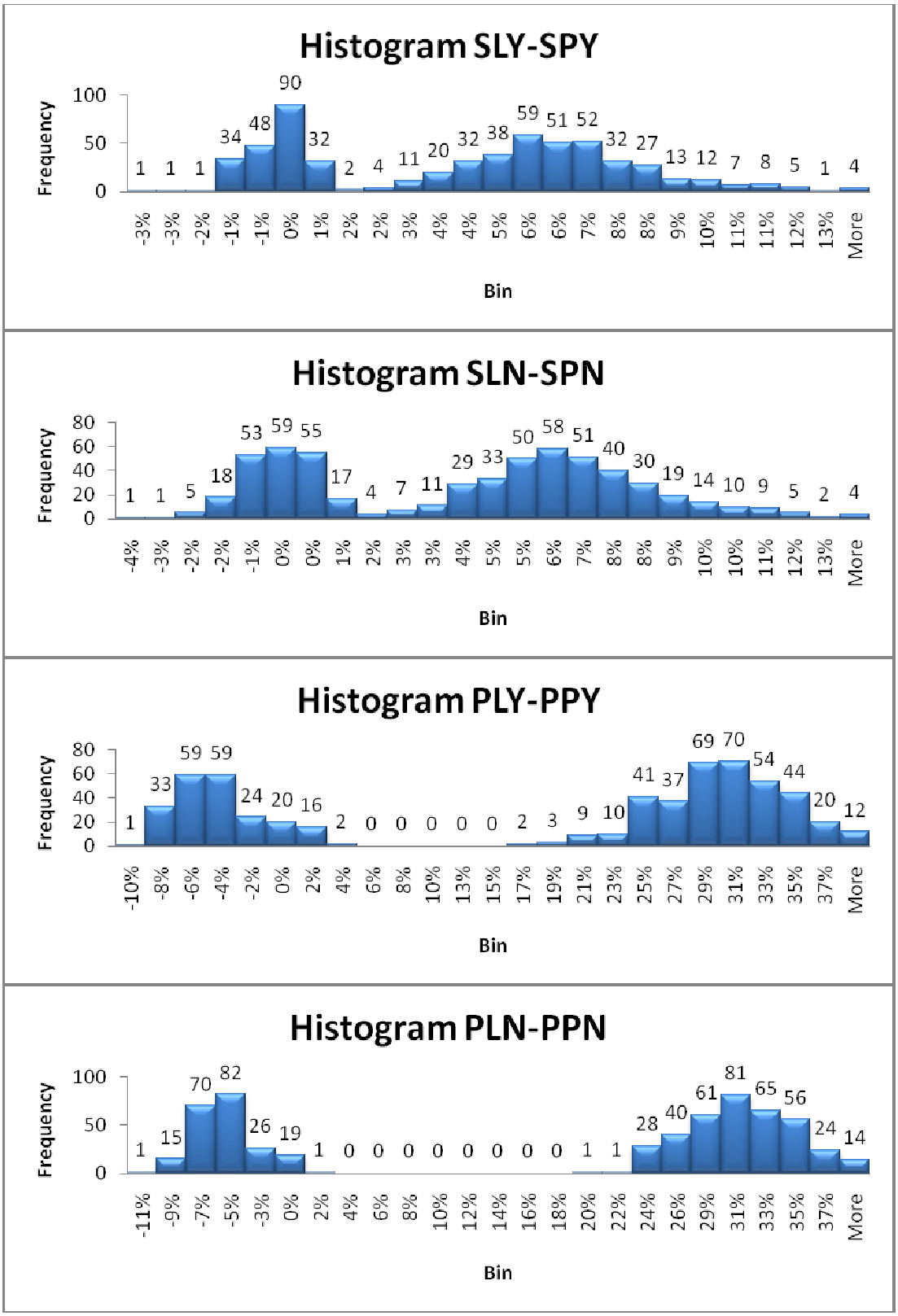
Payment allocation

A similar methodology was used to evaluate the effects of using a like-for-like payment allocation compared to a pro-rata payment allocation on the performance of the test-structures. Again structures sharing two of the three structural features will be compared against the third feature. The results of this comparison are summarised in the table below:

Payment allocation	SLY>SPY	SLN>SPN	PLY>PPY	PLN>PPN
Number of changes	584.00	585.00	585.00	585.00
Average change	3.41%	3.37%	16.67%	16.81%
Standard deviation	0.0447	0.04625	0.1676	0.17641
Skewness	0,0691	0,00336	-0,4652	-0,48938
Kurtosis	-1,014	-1,09417	-1,5864	-1,6292

The summary shows that structures using a like-for-like payment allocation are able to achieve higher BDRs than structures using a pro-rata funds allocation. When a senior ranking VFN is used, this difference is smaller than when a pari-passu ranking VFN is used; however both differences are significant. The standard deviation of the difference between the pair-wise compared structures is rather large for the structures including a pari-passu ranking VFN; larger than the actual difference. This large standard deviation translates into a negative kurtosis and a platykurtic distribution for the differences. This would suggest that there is a wide variety among the results and even though they do not cluster around the mean there are not many large outliers. However, appearances can be deceitful. The histograms on the next page show that each of these distributions consists of two distinct peaks. While this means that the results do not cluster around the mean, there are many outliers.

The negative skew of the PLY-PPY and PLN-PPN indicates that the mass of the distribution is concentrated on the right side of the mean average change. Thereby it is also suggesting that the diversion from the mean is on average larger on the left side.


Histogram SLY-SPY
Frequency
100
50
0
1 1 1 34 48 90 32 2 4 11 20 32 38 59 51 52 32 27 13 12 7 8 5 1 4
-3% -3% -2% -1% -1% 0% 1% 2% 2% 3% 4% 4% 5% 6% 6% 7% 8% 8% 9% 10% 11% 11% 12% 13% More
Bin
Histogram SLN-SPN
Frequency
80
60
40
20
0
1 1 5 18 53 59 55 17 4 7 11 29 33 50 58 51 40 30 19 14 10 9 5 2 4
-4% -3% -2% -2% -1% 0% 0% 1% 2% 3% 3% 4% 5% 5% 6% 7% 8% 8% 9% 10% 10% 11% 12% 13% More
Bin
Histogram PLY-PPY
Frequency
80
60
40
20
0
1 33 59 59 24 20 16 2 0 0 0 0 0 2 3 9 10 41 37 69 70 54 44 20 12
-10% -8% -6% -4% -2% 0% 2% 4% 6% 8% 10% 13% 15% 17% 19% 21% 23% 25% 27% 29% 31% 33% 35% 37% More
Bin
Histogram PLN-PPN
Frequency
100
50
0
1 15 70 82 26 19 1 0 0 0 0 0 0 0 0 1 1 28 40 61 81 65 56 24 14
-11% -9% -7% -5% -3% 0% 2% 4% 6% 8% 10% 12% 14% 16% 18% 20% 22% 24% 26% 29% 31% 33% 35% 37% More
Bin

The results shown in the summary above are based on the data obtained by running the S&P stress scenarios. In order to determine how the various rating parameters contributed to these results and why the twin-peaked distributions are observed in the histograms, the tables below provide an overview of the number of times each specific rating parameter was included in a stress scenario and whether that specific rating scenario favoured a like-for-like payment allocation (on the right) or a pro-rata payment allocation (on the left). The numbers in these tables represent the number of scenarios with each specific category.

Default timing	SLY <SPY	SLN <SPN	PLY <PPY	PLN <PPN	Default timing	SLY >SPY	SLN >SPN	PLY >PPY	PLN >PPN
	578	**578**	**578**	**578**		**578**	**578**	**578**	**578**
1	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00
2	1.00	1.00	1.00	2.00	2	1.00	1.00	1.00	0.00
3	3.00	6.00	4.00	10.00	3	6.00	4.00	6.00	0.00
4	2.00	11.00	3.00	16.00	4	14.00	5.00	13.00	0.00
5	11.00	19.00	17.00	19.00	5	8.00	0.00	2.00	0.00
6	13.00	15.00	15.00	15.00	6	73.00	71.00	71.00	71.00
7	23.00	23.00	24.00	24.00	7	101.00	101.00	100.00	100.00
8	41.00	41.00	49.00	49.00	8	108.00	108.00	100.00	100.00
9	71.00	71.00	79.00	79.00	9	108.00	108.00	100.00	100.00

It appears as not much can be said about the impact the timing of the defaults has on the difference between the pairs, other than confirming that the majority of the observations show a slight improvement when a like-for-like payment allocation is used. Further scrutiny, however, shows that the structures which allow redenomination and use a like-for-like payment allocation are able to achieve a higher BDR when the first default occurs during the first 6 years of the lifetime of the transaction. Presumably this difference is a consequence of the ability to redenominate as the difference disappears in year 7, when the reinvestment period ends (and redenomination is no longer allowed).

EURIBOR	SLY <SPY	SLN <SPN	PLY <PPY	PLN <PPN	EURIBOR	SLY >SPY	SLN >SPN	PLY >PPY	PLN >PPN
FWD	32.00	32.00	31.00	31.00	FWD	73.00	73.00	74.00	74.00
AAA UP	52.00	62.00	71.00	85.00	AAA UP	106.00	97.00	88.00	74.00
AAA Down	13.00	13.00	11.00	11.00	AAA Down	72.00	72.00	74.00	74.00
AAA UP/down	35.00	35.00	43.00	43.00	AAA UP/down	82.00	82.00	74.00	74.00
AAA down/UP	33.00	45.00	36.00	44.00	AAA down/UP	86.00	74.00	83.00	75.00

The slope of the EURIBOR index does not lend itself for any new conclusions to be drawn. It does confirm the earlier observation that the combination of a like-for-likes payment allocation and a senior VFN benefits more from an upwards sloping EURIBOR index than structures in which the VFN ranks pari-passu.

LIBOR	SLY <SPY	SLN <SPN	PLY <PPY	PLN <PPN	LIBOR	SLY >SPY	SLN >SPN	PLY >PPY	PLN >PPN
FWD	4.00	4.00	11.00	12.00	FWD	83.00	83.00	76.00	75.00
AAA UP	106.00	121.00	111.00	123.00	AAA UP	91.00	77.00	87.00	75.00
AAA Down	2.00	1.00	1.00	1.00	AAA Down	70.00	71.00	71.00	71.00
AAA UP/down	35.00	34.00	38.00	39.00	AAA UP/down	79.00	80.00	76.00	75.00
AAA down/UP	18.00	27.00	31.00	39.00	AAA down/UP	96.00	87.00	83.00	75.00

Whilst the influence of the parameter related to EURIBOR index isn't easily deduced, the influence of the LIBOR index seems to be very outspoken. Structures using a pro-rata payment allocation seem to benefit greatly from an upwards sloping LIBOR curve, whilst structures with like-for-like payment allocation perform better when the index has any other behaviour.

FX	SLY <SPY	SLN <SPN	PLY <PPY	PLN <PPN	FX	SLY >SPY	SLN >SPN	PLY >PPY	PLN >PPN
FWD	71.00	82.00	95.00	106.00	FWD	34.00	24.00	11.00	0.00
AAA UP	9.00	9.00	0.00	0.00	AAA UP	362.00	362.00	371.00	371.00
AAA Down	85.00	96.00	97.00	108.00	AAA Down	23.00	12.00	11.00	0.00

Similar to the LIBOR index, the FX-index shows unequivocal results. An upwards moving FX-index is in favour of a like-for-like payment allocation, while a pro-rata allocation provides better results under a forward or downwards sloping FX-index.

Default pattern	SLY <SPY	SLN <SPN	PLY <PPY	PLN <PPN	Default pattern	SLY >SPY	SLN >SPN	PLY >PPY	PLN >PPN
15/30/30/15/10	63.00	70.00	75.00	86.00	15/30/30/15/10	123.00	116.00	111.00	100.00
20/20/20/20/20	24.00	25.00	24.00	25.00	20/20/20/20/20	101.00	100.00	101.00	100.00
25/25/25/25	45.00	57.00	63.00	71.00	25/25/25/25	121.00	110.00	104.00	96.00
40/20/20/10/10	33.00	35.00	30.00	32.00	40/20/20/10/10	74.00	72.00	77.00	75.00

This outspokenness appears to be absent when the parameter governing the default patter is observed. Therefore it is concluded that BDR a structure including a pro-rata or like-for-like payment allocation does not seem to be significantly influence by the default pattern used to stress the structures. Nevertheless, the table does confirm that the structures using a like for like payment allocation generally outperform the structures using a pari-passu allocation.

Interest Indices (EURIBOR&LIBOR)	SLY <SPY	SLN <SPN	PLY <PPY	PLN <PPN	Interest Indices (EURIBOR&LIBOR)	SLY >SPY	SLN >SPN	PLY >PPY	PLN >PPN
FWD & FWD	0.00	0.00	0.00	0.00	FWD & FWD	15.00	15.00	15.00	15.00
FWD & AAA UP	24.00	24.00	23.00	23.00	FWD & AAA UP	14.00	14.00	15.00	15.00
FWD & AAA Down	0.00	0.00	0.00	0.00	FWD & AAA Down	14.00	14.00	14.00	14.00
FWD & AAA UP/down	8.00	8.00	8.00	8.00	FWD & AAA UP/down	15.00	15.00	15.00	15.00
FWD & AAA down/UP	0.00	0.00	0.00	0.00	FWD & AAA down/UP	15.00	15.00	15.00	15.00
AAA UP & FWD	3.00	3.00	7.00	8.00	AAA UP & FWD	20.00	20.00	16.00	15.00
AAA UP & AAA UP	29.00	37.00	33.00	41.00	AAA UP & AAA UP	26.00	19.00	23.00	15.00
AAA UP & AAA Down	1.00	0.00	1.00	1.00	AAA UP &AAA Down	14.00	15.00	14.00	14.00
AAA UP & AAA UP/down	8.00	7.00	12.00	13.00	AAA UP & AAA UP/down	20.00	21.00	16.00	15.00
AAA UP & AAA down/UP	11.00	15.00	18.00	22.00	AAA UP & AAA down/UP	26.00	22.00	19.00	15.00
AAA Down & FWD	0.00	0.00	0.00	0.00	AAA Down & FWD	15.00	15.00	15.00	15.00
AAA Down & AAA UP	10.00	10.00	9.00	9.00	AAA Down & AAA UP	14.00	14.00	15.00	15.00
AAA Down & AAA Down	0.00	0.00	0.00	0.00	AAA Down & AAA Down	14.00	14.00	14.00	14.00
AAA Down & AAA UP/down	2.00	2.00	2.00	2.00	AAA Down & AAA UP/down	15.00	15.00	15.00	15.00
AAA Down & AAA down/UP	1.00	1.00	0.00	0.00	AAA Down & AAA down/UP	14.00	14.00	15.00	15.00
AAA UP/down & FWD	0.00	0.00	4.00	4.00	AAA UP/down & FWD	19.00	19.00	15.00	15.00
AAA UP/down & AAA UP	20.00	20.00	20.00	20.00	AAA UP/down & AAA UP	15.00	15.00	15.00	15.00
AAA UP/down & AAA Down	1.00	1.00	0.00	0.00	AAA UP/down& AAA Down	13.00	13.00	14.00	14.00
AAA UP/down & AAA UP/down	14.00	14.00	13.00	13.00	AAA UP/down & AAA UP/down	14.00	14.00	15.00	15.00
AAA UP/down & AAA down/UP	0.00	0.00	6.00	6.00	AAA UP/down & AAA down/UP	21.00	21.00	15.00	15.00
AAA down/UP & FWD	1.00	1.00	0.00	0.00	AAA down/UP & FWD	14.00	14.00	15.00	15.00
AAA down/UP & AAA UP	23.00	30.00	26.00	30.00	AAA down/UP & AAA UP	22.00	15.00	19.00	15.00
AAA down/UP & AAA Down	0.00	0.00	0.00	0.00	AAA down/UP & AAA Down	15.00	15.00	15.00	15.00
AAA down/UP & AAA UP/down	3.00	3.00	3.00	3.00	AAA down/UP & AAA UP/down	15.00	15.00	15.00	15.00
AAA down/UP & AAA down/UP	6.00	11.00	7.00	11.00	AAA down/UP & AAA down/UP	20.00	15.00	19.00	15.00
Total	165.00	187.00	192.00	214.00	Total	419.00	398.00	393.00	371.00

The final table used in the pair-wise comparison between the structures using a like-for-like and a pro-rata payment allocation combines the influences of both the interest indices. The data in this table strongly suggests that the structures using a pro-rata payment allocation benefit from an upwards sloping LIBOR index. This benefit seems largely independent on the movement of the EURIBOR index. Nevertheless, when the slope of EURIBOR index is exactly the opposite of the slope of the LIBOR curve structures with like-for-like payment perform better.

Conclusion payment allocation

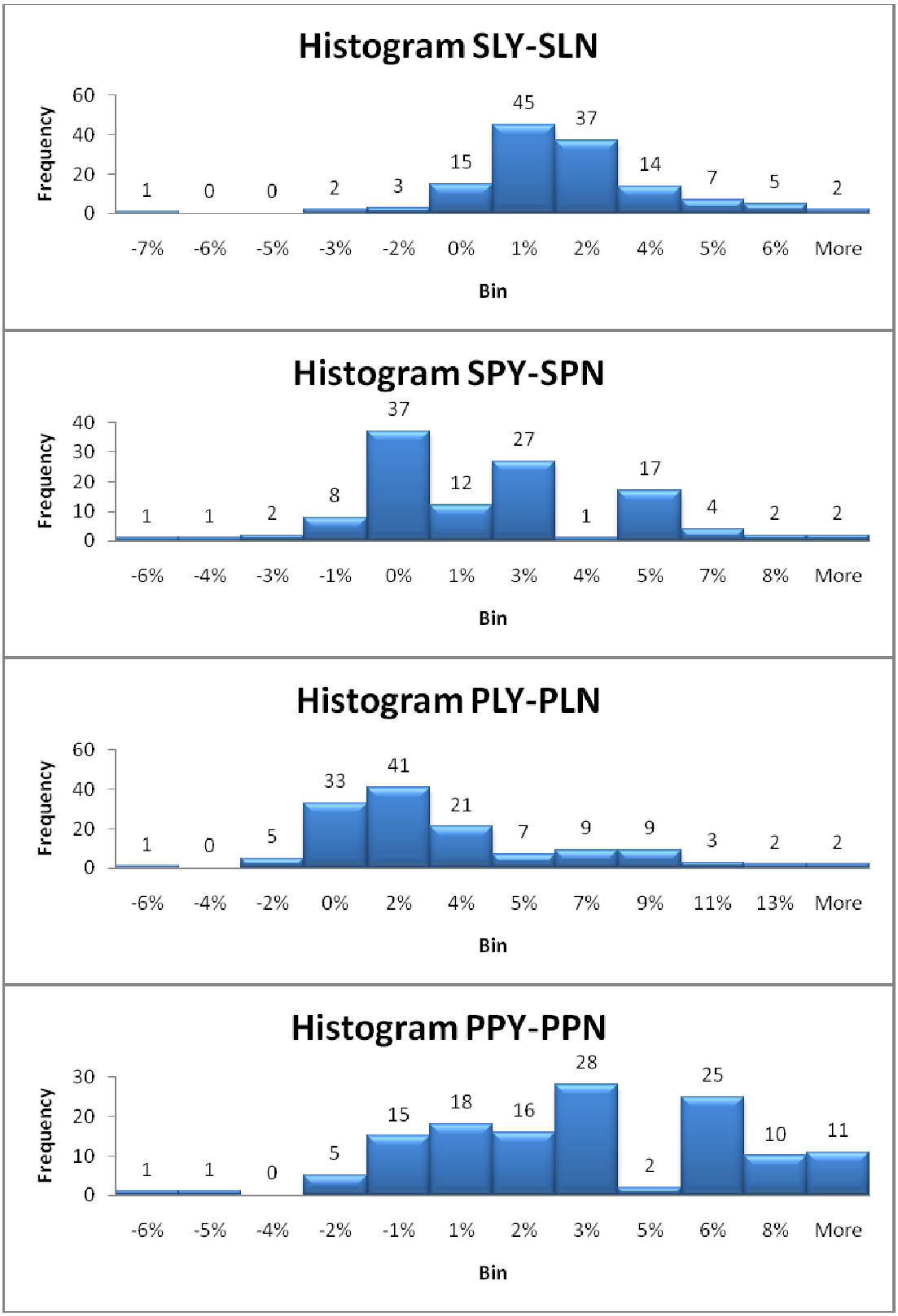
Based on the conclusions formulated above it appears that the difference between a structure using a like-for-like payment allocation and one which uses a pro-rata payment allocation is ambiguous. The histograms show two distinctive peaks. Around the left peak a cluster of scenarios is formed for which the pro-rata allocation outperforms the like-for-like allocation, while this is reversed for the right peak. These peaks are a consequence of the different sensitivities of the structures to different rating parameters. For one set of parameters a like-for-like payment allocation clearly outperforms a pro-rata allocation, for example for a forward or downwards sloping LIBOR index and an appreciating Sterling. In contrast, a structure using a pro-rata payment allocation has a higher BDR when an upwards sloping LIBOR index is applied and the value of the Pound remains stable or depreciates.

Redenomination

This appendix will be concluded with the pair-wise comparison between the different structures which allow for redenomination and those which don't. As redenomination is only allowed during the reinvestment period (the first 6 years of the life of the transaction), the BDR levels are similar when defaults start in year 7 or later. Unfortunately the 585 scenarios which were found to be most stressful for the test-structures included only 133 structures in which the first default occurs before year 7. These 133 structures will be used in this comparison. A summary of the difference found between the pair-wise compared structures is included in the table below:

Redenomination	SLY-SLN	SPY-SPN	PLY-PLN	PPY-PPN
Number of changes	133.00	132.00	133.00	132.00
Average change	1.15%	0.98%	1.91%	2.57%
Standard deviation	0.02	0.02345	0.03478	0.03236
Skewness	0,93	1,08517	0,8499	0,08227
kurtosis	1,97	0,836	1,09489	-0,51409

The summary shows that the ability to redenominate allows a structure to sustain a higher default rate regardless of the other structural features. This difference is most profound when a structure uses a pari-passu ranking. Nevertheless the difference remains small in absolute terms. The standard deviation of the difference between the pair-wise compared structures is relatively small; indicating that most values only show a small deviation from the mean. The structures are slightly skewed to the left and leptokurtic. This translates to a distribution which has more mass to the left of the mean value and tail slightly fatter than the Gaussian. The conclusions are confirmed by the histograms below.


Histogram SLY-SLN
Frequency
60
40
20
0
1
0
0
2
3
15
45
37
14
7
5
2
-7%
-6%
-5%
-3%
-2%
0%
1%
2%
4%
5%
6%
More
Bin
Histogram SPY-SPN
Frequency
40
30
20
10
0
1
1
2
8
37
12
27
1
17
4
2
2
-6%
-4%
-3%
-1%
0%
1%
3%
4%
5%
7%
8%
More
Bin
Histogram PLY-PLN
Frequency
60
40
20
0
1
0
5
33
41
21
7
9
9
3
2
2
-6%
-4%
-2%
0%
2%
4%
5%
7%
9%
11%
13%
More
Bin
Histogram PPY-PPN
Frequency
30
20
10
0
1
1
0
5
15
18
16
28
2
25
10
11
-6%
-5%
-4%
-2%
-1%
1%
2%
3%
5%
6%
8%
More
Bin

In order to determine how the various rating parameters contributed to these results, the tables below provide an overview of the number of times each specific rating parameter was included in a stress scenario and whether that specific rating scenario contributed to an increase in the BDR when redenomination was allowed (on the right) or resulted in a decrease (on the left).

Default timing	SLY <SLN	SPY <SPN	PLY <PLN	PPY <PPN	Default timing	SLY >SLN	SPY >SPN	PLY >PLN	PPY >PPN
	133.00	132.00	133.00	132.00		133.00	132.00	133.00	132.00
1	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00
2	1.00	2.00	0.00	1.00	2	1.00	0.00	2.00	1.00
3	7.00	9.00	3.00	8.00	3	3.00	1.00	7.00	2.00
4	5.00	11.00	1.00	7.00	4	11.00	5.00	15.00	9.00
5	6.00	16.00	2.00	8.00	5	13.00	3.00	17.00	11.00
6	12.00	21.00	42.00	9.00	6	74.00	64.00	44.00	76.00
7	0.00	0.00	0.00	0.00	7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	9	0.00	0.00	0.00	0.00

The table covering the S&P rating parameter related to the default timing confirms the expectation that no differences would be found when the defaults are started after year 6. In addition it seems that in most of the scenarios, regardless of what structures are compared, the ability to redenominate helps performance.

EURIBOR	SLY <SLN	SPY <SPN	PLY <PLN	PPY <PPN	EURIBOR	SLY >SLN	SPY >SPN	PLY >PLN	PPY >PPN
FWD	1.00	4.00	4.00	0.00	FWD	13.00	10.00	10.00	14.00
AAA UP	25.00	35.00	24.00	26.00	AAA UP	28.00	18.00	29.00	27.00
AAA Down	0.00	0.00	1.00	0.00	AAA Down	14.00	14.00	13.00	14.00
AAA UP/down	1.00	3.00	7.00	0.00	AAA UP/down	13.00	10.00	7.00	14.00
AAA down/UP	4.00	17.00	12.00	7.00	AAA down/UP	34.00	21.00	26.00	30.00

Interestingly, the ability to redenominate makes the structures more sensitive to an upwards sloping EURIBOR index. This becomes apparent in the table in the form of a relatively large number of observations in the left table signifying a decrease in the BDR.

LIBOR	SLY <SLN	SPY <SPN	PLY <PLN	PPY <PPN	LIBOR	SLY >SLN	SPY >SPN	PLY >PLN	PPY >PPN
FWD	2.00	3.00	12.00	2.00	FWD	15.00	14.00	5.00	15.00
AAA UP	12.00	26.00	6.00	12.00	AAA UP	35.00	21.00	41.00	34.00
AAA Down	3.00	2.00	10.00	1.00	AAA Down	9.00	9.00	2.00	11.00
AAA UP/down	1.00	2.00	6.00	1.00	AAA UP/down	15.00	14.00	10.00	15.00
AAA down/UP	13.00	26.00	14.00	17.00	AAA down/UP	28.00	15.00	27.00	24.00

Simultaneously, the structures which allowed to redenominate appear to be more sensitive to an upwards moving LIBOR index. The notable exception being the structures

which include a pari-passu ranking VFN and a like-for-like payment allocation, which appears to be more prone to a forward or downwards moving LIBOR index.

FX	SLY <SLN	SPY <SPN	PLY <PLN	PPY <PPN	FX	SLY >SLN	SPY >SPN	PLY >PLN	PPY >PPN
FWD	18.00	27.00	9.00	24.00	FWD	16.00	7.00	25.00	9.00
AAA UP	3.00	10.00	35.00	0.00	AAA UP	68.00	60.00	36.00	71.00
AAA Down	10.00	22.00	4.00	9.00	AAA Down	18.00	6.00	24.00	19.00

Similar to the LIBOR index, the FX-index shows unambiguous results. Under an upwards moving FX-index the ability to redenominate appears more valuable than under the other FX scenarios. Again the notable exception is the PLY - PLN pair, for which a significant number of scenarios show a decline in the BDR when the Sterling appreciates or depreciates against the Euro.

Default pattern	SLY <SLN	SPY <SPN	PLY <PLN	PPY <PPN	Default pattern	SLY >SLN	SPY >SPN	PLY >PLN	PPY >PPN
15/30/30/15/10	19.00	33.00	23.00	20.00	15/30/30/15/10	35.00	20.00	31.00	34.00
20/20/20/20/20	2.00	2.00	15.00	0.00	20/20/20/20/20	25.00	25.00	12.00	27.00
25/25/25/25	9.00	21.00	9.00	11.00	25/25/25/25	40.00	28.00	40.00	37.00
40/20/20/10/10	1.00	3.00	1.00	2.00	40/20/20/10/10	2.00	0.00	2.00	1.00

In the table related to the default pattern no significant differences appear between the various pairs, other than the increased sensitivity of the PLY - PLN pair to a 20/20/20/20/20 default pattern.

Interest Indices (EURIBOR&LIBOR)	SLY <SLN	SPY <SPN	PLY <PLN	PPY <PPN	Interest Indices (EURIBOR&LIBOR)	SLY >SLN	SPY >SPN	PLY >PLN	PPY >PPN
FWD & FWD	0.00	0.00	2.00	0.00	FWD & FWD	3.00	3.00	1.00	3.00
FWD & AAA UP	1.00	1.00	0.00	0.00	FWD & AAA UP	2.00	2.00	3.00	3.00
FWD & AAA Down	0.00	1.00	2.00	0.00	FWD & AAA Down	2.00	1.00	0.00	2.00
FWD & AAA UP/down	0.00	1.00	0.00	0.00	FWD & AAA UP/down	3.00	2.00	3.00	3.00
FWD & AAA down/UP	0.00	1.00	0.00	0.00	FWD & AAA down/UP	3.00	2.00	3.00	3.00
AAA UP & FWD	2.00	2.00	5.00	2.00	AAA UP & FWD	3.00	3.00	0.00	3.00
AAA UP & AAA UP	9.00	17.00	4.00	10.00	AAA UP & AAA UP	14.00	6.00	19.00	13.00
AAA UP & AAA Down	2.00	1.00	3.00	1.00	AAA UP &AAA Down	1.00	2.00	0.00	2.00
AAA UP & AAA UP/down	1.00	1.00	3.00	1.00	AAA UP & AAA UP/down	3.00	3.00	1.00	3.00
AAA UP & AAA down/UP	11.00	14.00	9.00	12.00	AAA UP & AAA down/UP	7.00	4.00	9.00	6.00
AAA Down & FWD	0.00	0.00	0.00	0.00	AAA Down & FWD	3.00	3.00	3.00	3.00
AAA Down & AAA UP	0.00	0.00	0.00	0.00	AAA Down & AAA UP	3.00	3.00	3.00	3.00
AAA Down & AAA Down	0.00	0.00	0.00	0.00	AAA Down & AAA Down	2.00	2.00	2.00	2.00
AAA Down & AAA UP/down	0.00	0.00	1.00	0.00	AAA Down & AAA UP/down	3.00	3.00	2.00	3.00
AAA Down & AAA down/UP	0.00	0.00	0.00	0.00	AAA Down & AAA down/UP	3.00	3.00	3.00	3.00
AAA UP/down & FWD	0.00	1.00	3.00	0.00	AAA UP/down & FWD	3.00	2.00	0.00	3.00
AAA UP/down & AAA UP	0.00	1.00	0.00	0.00	AAA UP/down & AAA UP	3.00	2.00	3.00	3.00
AAA UP/down & AAA Down	1.00	0.00	2.00	0.00	AAA UP/down& AAA Down	1.00	1.00	0.00	2.00
AAA UP/down & AAA UP/down	0.00	0.00	1.00	0.00	AAA UP/down & AAA UP/down	3.00	3.00	2.00	3.00
AAA UP/down & AAA down/UP	0.00	1.00	1.00	0.00	AAA UP/down & AAA down/UP	3.00	2.00	2.00	3.00
AAA down/UP & FWD	0.00	0.00	2.00	0.00	AAA down/UP & FWD	3.00	3.00	1.00	3.00
AAA down/UP & AAA UP	2.00	7.00	2.00	2.00	AAA down/UP & AAA UP	13.00	8.00	13.00	12.00
AAA down/UP & AAA Down	0.00	0.00	3.00	0.00	AAA down/UP & AAA Down	3.00	3.00	0.00	3.00
AAA down/UP & AAA UP/down	0.00	0.00	1.00	0.00	AAA down/UP & AAA UP/down	3.00	3.00	2.00	3.00
AAA down/UP & AAA down/UP	2.00	10.00	4.00	5.00	AAA down/UP & AAA down/UP	12.00	4.00	10.00	9.00
Total	31,00	57,00	48,00	33,00	Total	102,00	75,00	85,00	99,00

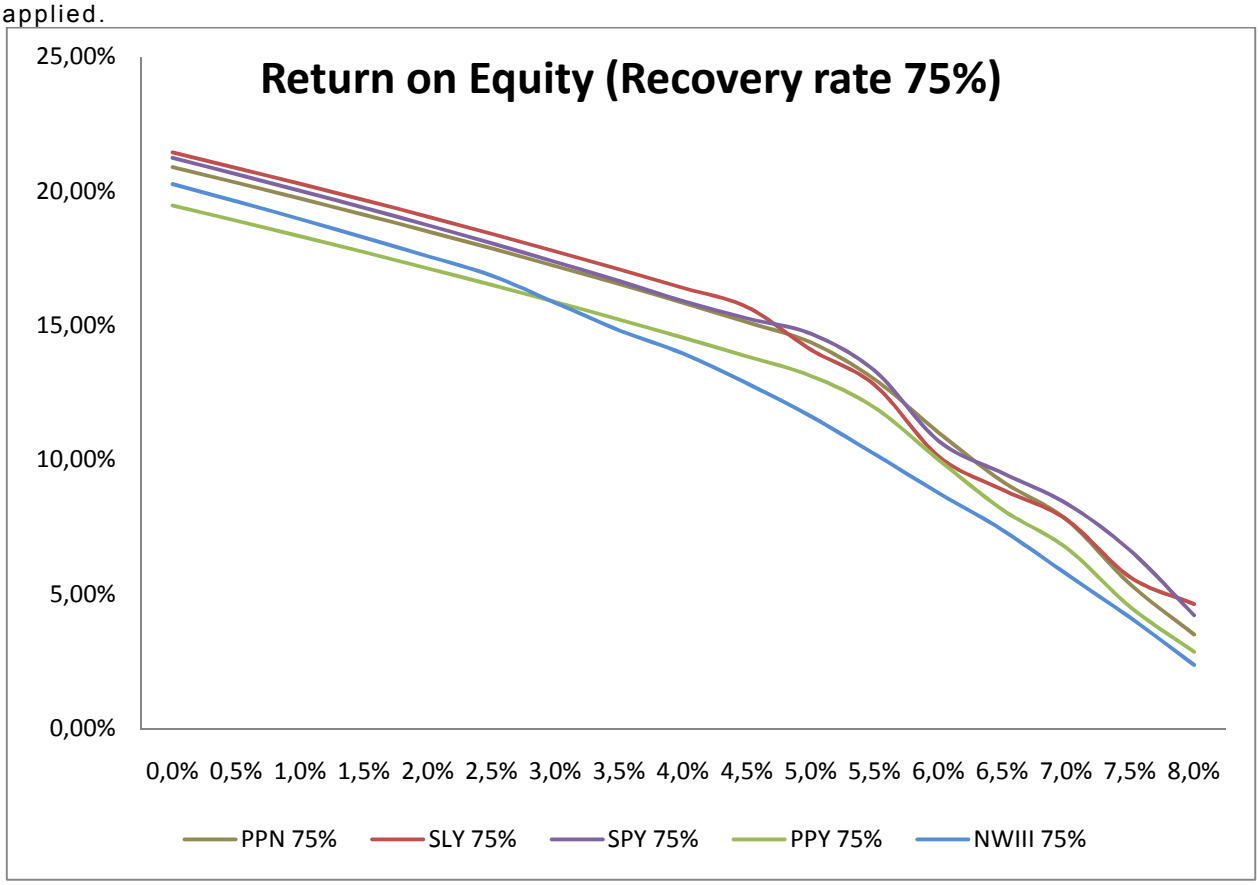
The low number of scenarios eligible for the pair-wise comparison and the large number of combinations between interest indices significantly limits the potential of this final analysis. The limited number of observations significantly reduces the validity of the potential conclusions. Therefore no conclusions will be drawn with regards to the movement of the interest rate indices and the effects on the structures allowed to redenominate.

Conclusion redenomination

Based on the analysis of the test results it can be concluded that the ability to redenominate is on average beneficial to a structure. Without exception the structures which allow to redenominate achieve a higher average BDR level than the structures which don't use this feature. Nevertheless, the histograms show that the ability to redenominate is not beneficial for each and every scenario. Apparently the option to redenominate does increase the structures sensitivity with regards to some of the stress parameters. This sensitivity is best observed in the tables governing the EURIBOR and LIBOR index, where an upwards slope of the index appears to be more stressful to a redenominating structure. Interestingly, the reverse of this observation appears to be true when both the indices follow this upwards pattern. This can be observed in the final table.

A.12 Return on Equity

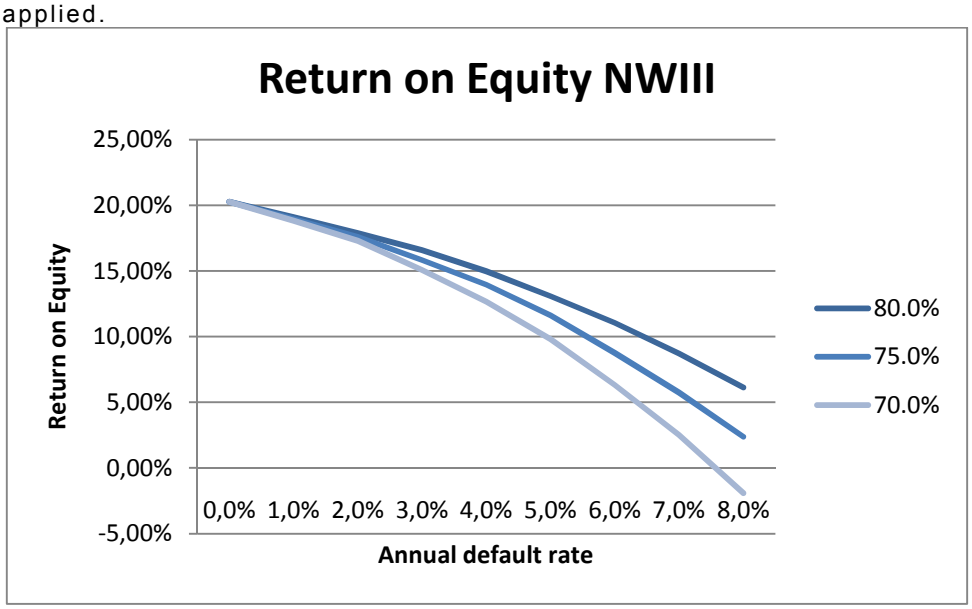
A.12 Figure 1: Return on Equity of the test-structures when different default rates are applied.



A.12 Table 1: Return on Equity of the test-structures when different default rates are applied.

Annual default rate	0,0%	1,0%	2,0%	3,0%	4,0%	5,0%	6,0%	7,0%	8,0%
NWIII 75%	20.26%	18.95%	17.58%	15.84%	13.95%	11.62%	8.76%	5.74%	2.36%
SLY 75%	21.45%	20.28%	19.05%	17.76%	16.40%	14.10%	10.13%	7.78%	4.63%
SPY 75%	21.24%	20.01%	18.73%	17.36%	15.91%	14.69%	10.70%	8.38%	4.21%
PPY 75%	19.47%	18.33%	17.13%	15.88%	14.55%	13.13%	10.00%	6.73%	2.86%
PPN 75%	20.89%	19.72%	18.50%	17.20%	15.84%	14.36%	11.01%	7.77%	3.49%

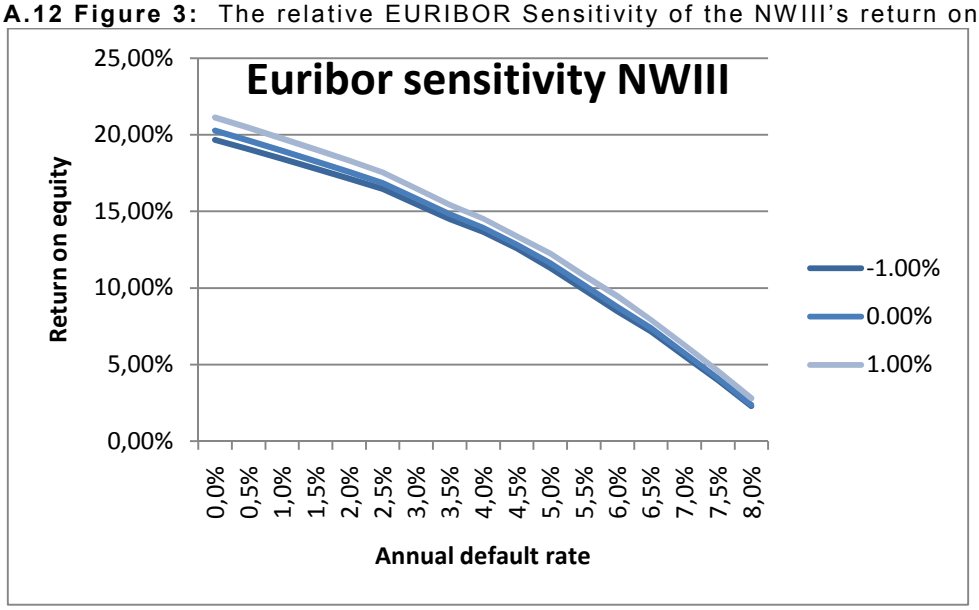
A.12 Figure 2: Return on equity of the NWIII using when different default rates are applied.



A.12 Table 2: Return on equity of the NWIII using when different default rates are applied.

Annual default Rate		0.0%	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%
Recovery Rate	80.0%	20.26%	19.09%	17.86%	16.59%	14.98%	13.06%	11.06%	8.71%	6.13%
	75.0%	20.26%	18.95%	17.58%	15.84%	13.95%	11.62%	8.76%	5.74%	2.36%
	70.0%	20.26%	18.82%	17.28%	15.07%	12.67%	9.81%	6.32%	2.51%	-1.91%

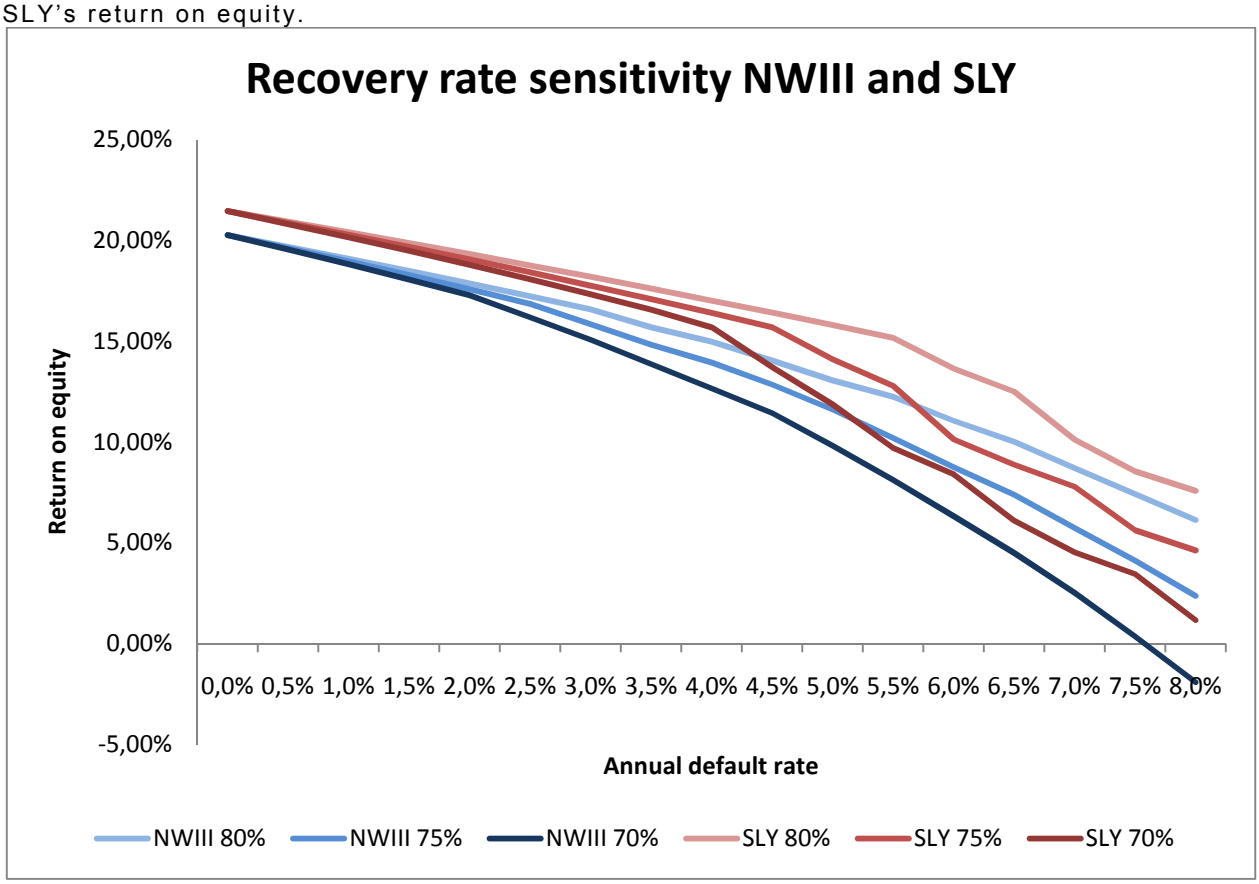
A.12 Figure 3: The relative EURIBOR Sensitivity of the NWIII's return on equity.



A.12 Table 3: The relative EURIBOR Sensitivity of the NWIII's return on equity.

Annual default rate		0.0%	1.0%	2.0%	3.0%	4.0%	5.0%	6.0%	7.0%	8.0%
Shift interest curve	-1.00%	19.66%	18.43%	17.14%	15.48%	13.66%	11.31%	8.48%	5.54%	2.28%
	0.00%	20.26%	18.95%	17.58%	15.84%	13.95%	11.62%	8.76%	5.74%	2.36%
	1.00%	21.14%	19.76%	18.30%	16.49%	14.52%	12.25%	9.47%	6.27%	2.80%

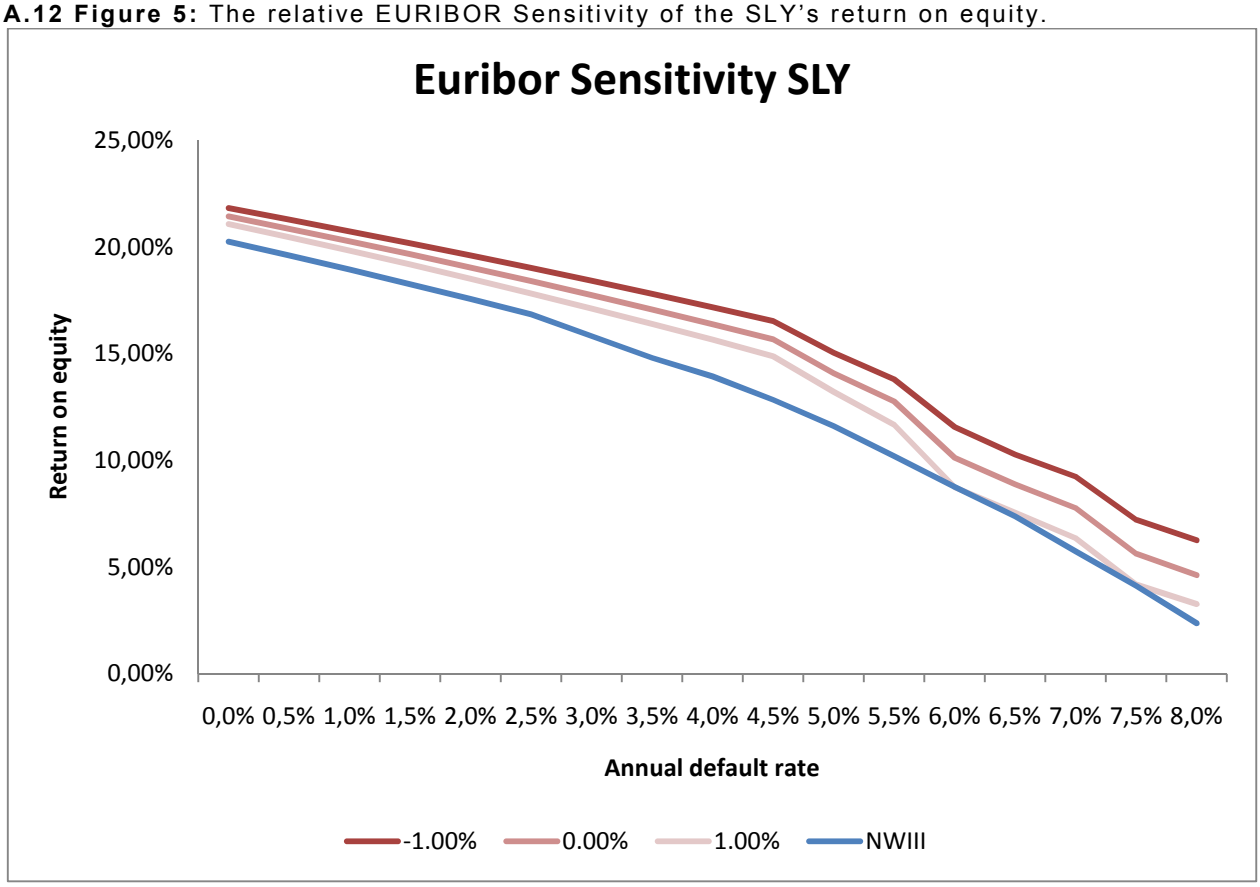
A.12 Figure 4: The relative Sensitivity to changes in the recovery rate assumptions of the SLY's return on equity.



A.12 Table 4: The relative Sensitivity to changes in the recovery rate assumptions of the SLY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
Recovery rate	80%	21.45%	20.40%	19.32%	18.19%	17.02%	15.80%	13.65%	10.12%	7.58%
	75%	21.45%	20.28%	19.05%	17.76%	16.40%	14.10%	10.13%	7.78%	4.63%
	70%	21.45%	20.16%	18.79%	17.33%	15.70%	11.87%	8.40%	4.53%	1.17%

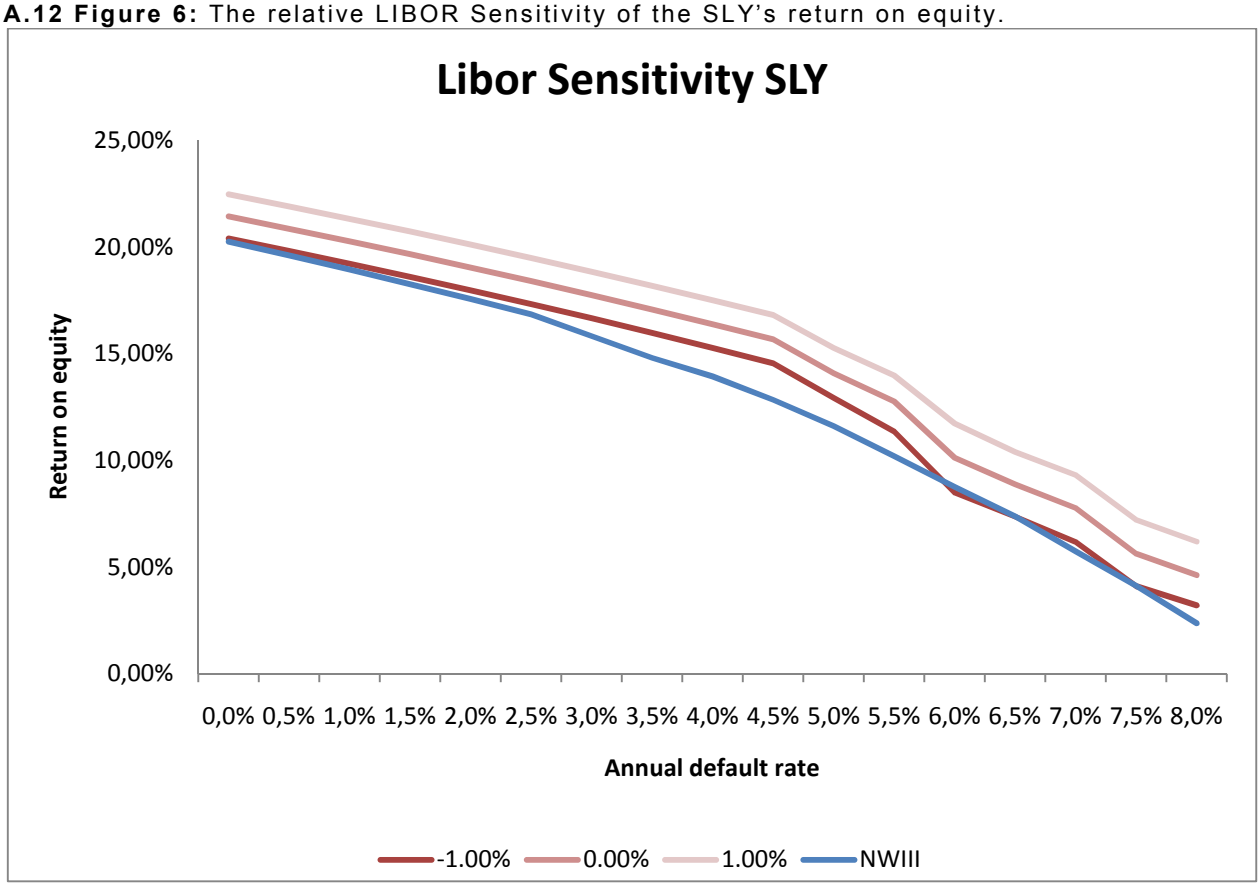
A.12 Figure 5: The relative EURIBOR Sensitivity of the SLY's return on equity.



A.12 Table 5: The relative EURIBOR Sensitivity of the SLY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
Shift Interest Rate Curve	-1%	21.84%	20.75%	19.62%	18.43%	17.19%	15.05%	11.57%	9.24%	6.26%
	0	21.45%	20.28%	19.05%	17.76%	16.40%	14.10%	10.13%	7.78%	4.63%
	1%	21.09%	19.84%	18.53%	17.14%	15.67%	13.22%	8.75%	6.37%	3.28%

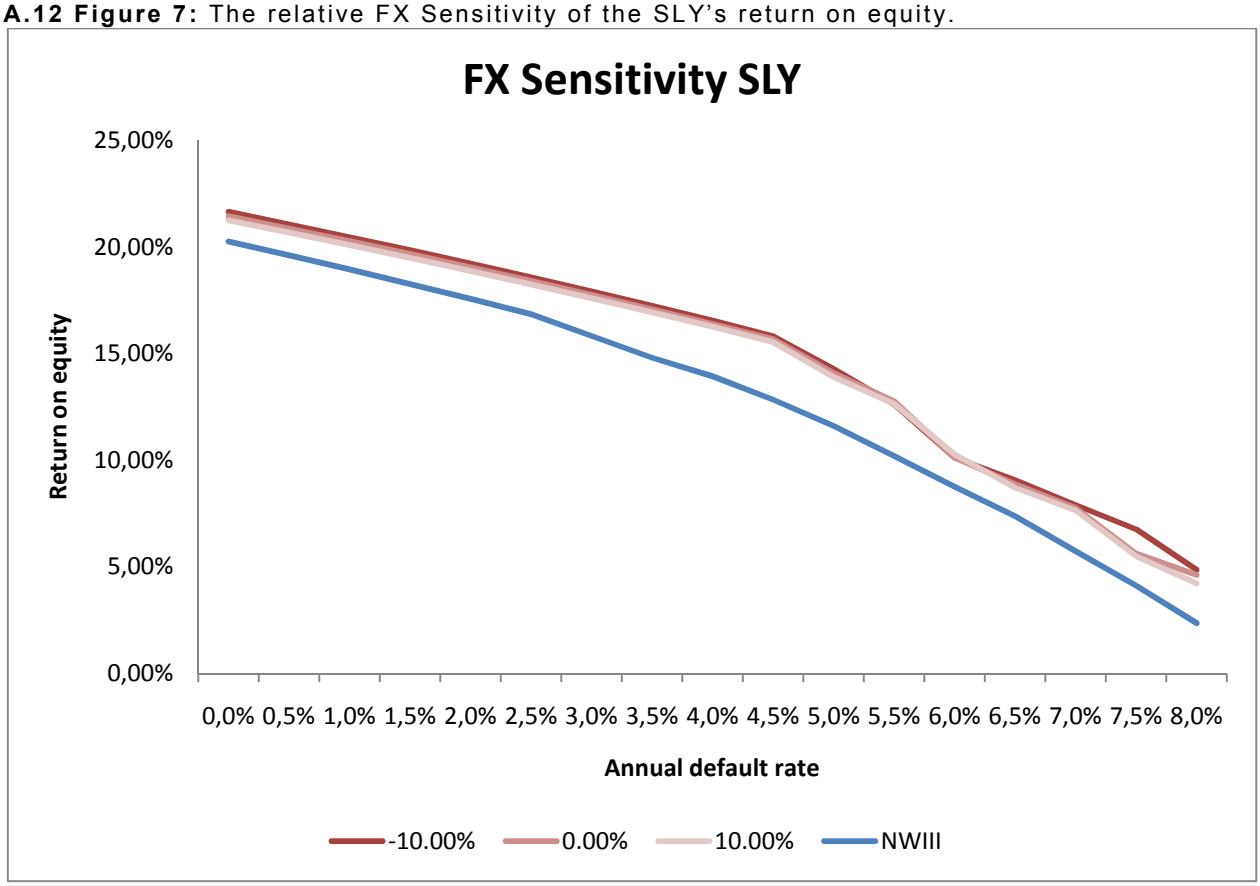
A.12 Figure 6: The relative LIBOR Sensitivity of the SLY's return on equity.



A.12 Table 6: The relative LIBOR Sensitivity of the SLY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
LIBOR Interest Rate Curve	-1%	20.41%	19.23%	17.99%	16.67%	15.29%	12.94%	8.49%	6.18%	3.22%
	0	21.45%	20.28%	19.05%	17.76%	16.40%	14.10%	10.13%	7.78%	4.63%
	1%	22.49%	21.34%	20.13%	18.86%	17.52%	15.28%	11.74%	9.32%	6.20%

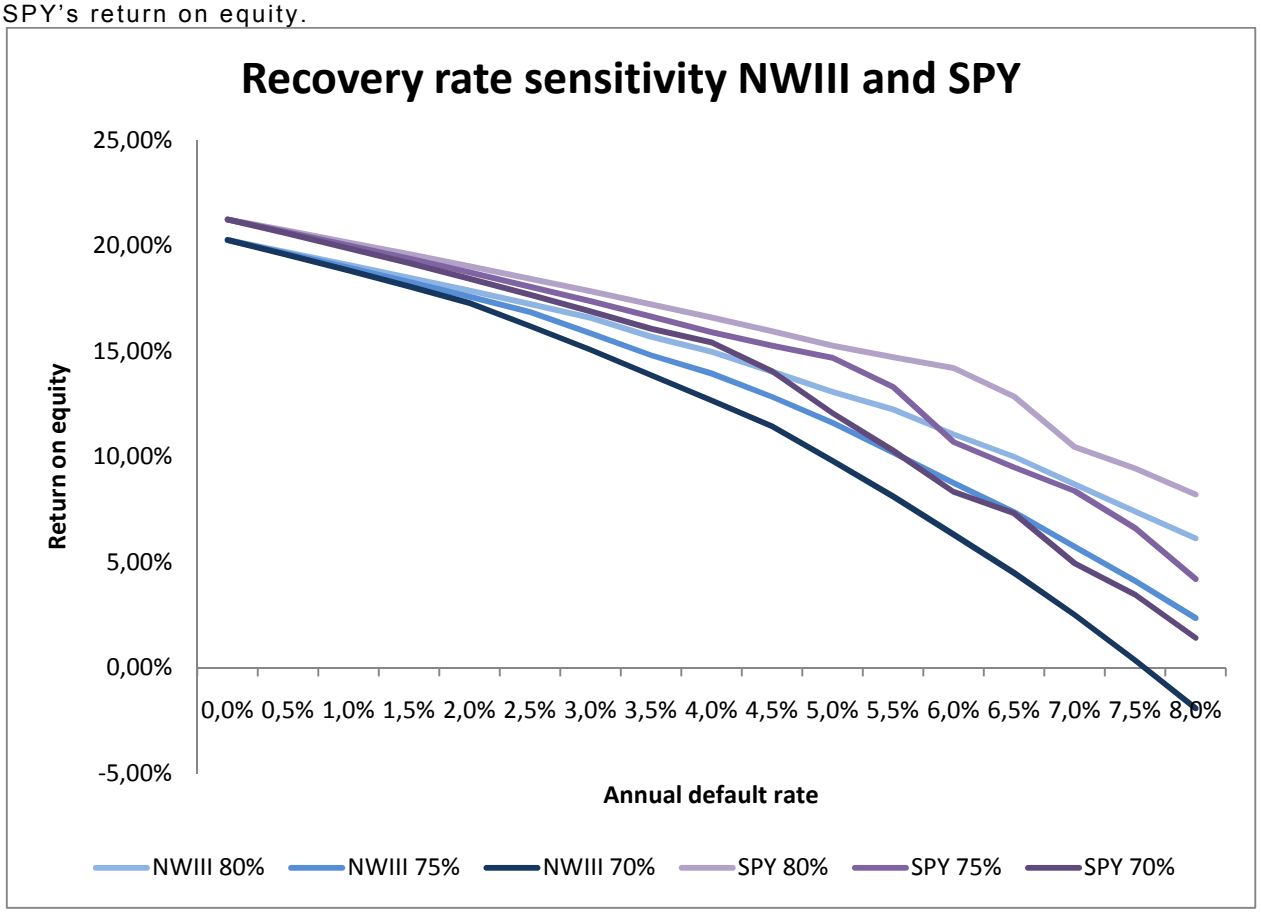
A.12 Figure 7: The relative FX Sensitivity of the SLY's return on equity.



A.12 Table 7: The relative FX Sensitivity of the SLY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
FX Curve	-10%	21.66%	20.47%	19.23%	17.93%	16.55%	14.28%	10.14%	7.92%	4.86%
	0	21.45%	20.28%	19.05%	17.76%	16.40%	14.10%	10.13%	7.78%	4.63%
	10%	21.26%	20.09%	18.88%	17.62%	16.27%	13.92%	10.28%	7.65%	4.24%

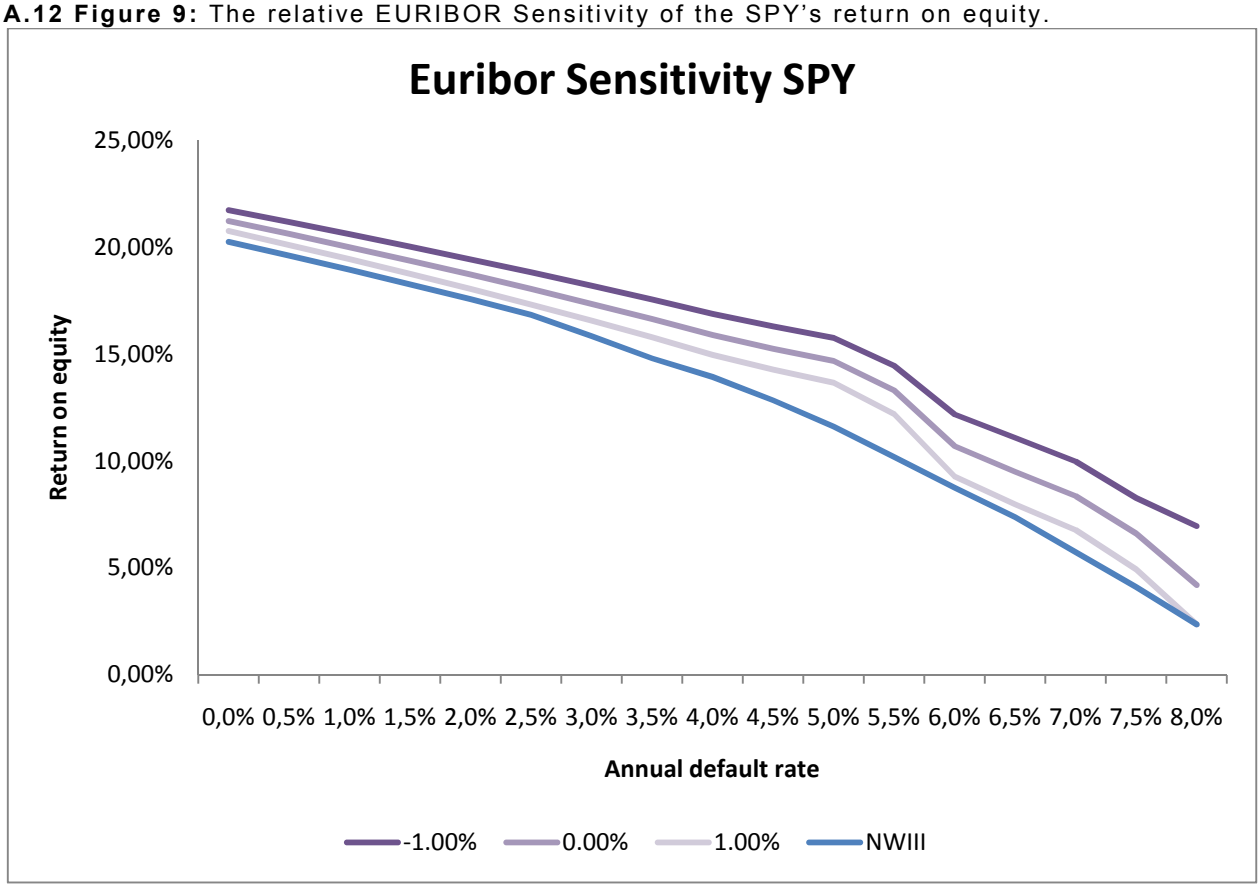
A.12 Figure 8: The relative Sensitivity to changes in the recovery rate assumptions of the SPY's return on equity.



A.12 Table 8: The relative Sensitivity to changes in the recovery rate assumptions of the SPY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
Recovery rate	80%	21.24%	20.15%	19.02%	17.84%	16.59%	15.27%	14.21%	10.45%	8.21%
	75%	21.24%	20.01%	18.73%	17.36%	15.91%	14.69%	10.70%	8.38%	4.21%
	70%	21.24%	19.88%	18.44%	16.88%	15.42%	12.06%	8.34%	4.96%	1.43%

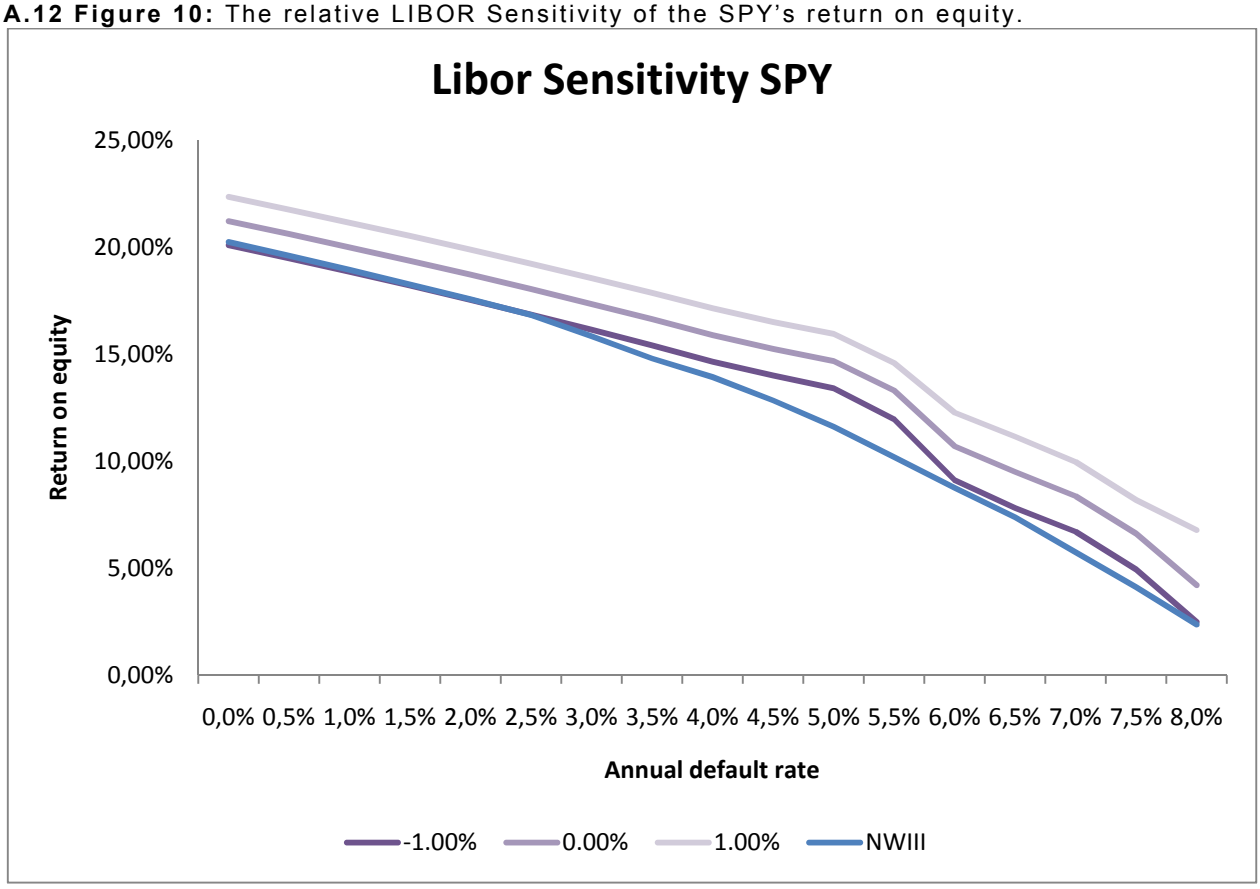
A.12 Figure 9: The relative EURIBOR Sensitivity of the SPY's return on equity.



A.12 Table 9: The relative EURIBOR Sensitivity of the SPY's return on equity.

Annual default	rate	0%	1%	2%	3%	4%	5%	6%	7%	8%
Shift Interest Rate Curve	-1%	21.74%	20.62%	19.45%	18.20%	16.89%	15.77%	12.19%	9.99%	6.96%
	0	21.24%	20.01%	18.73%	17.36%	15.91%	14.69%	10.70%	8.38%	4.21%
	1%	20.77%	19.45%	18.06%	16.58%	14.98%	13.67%	9.29%	6.79%	2.36%

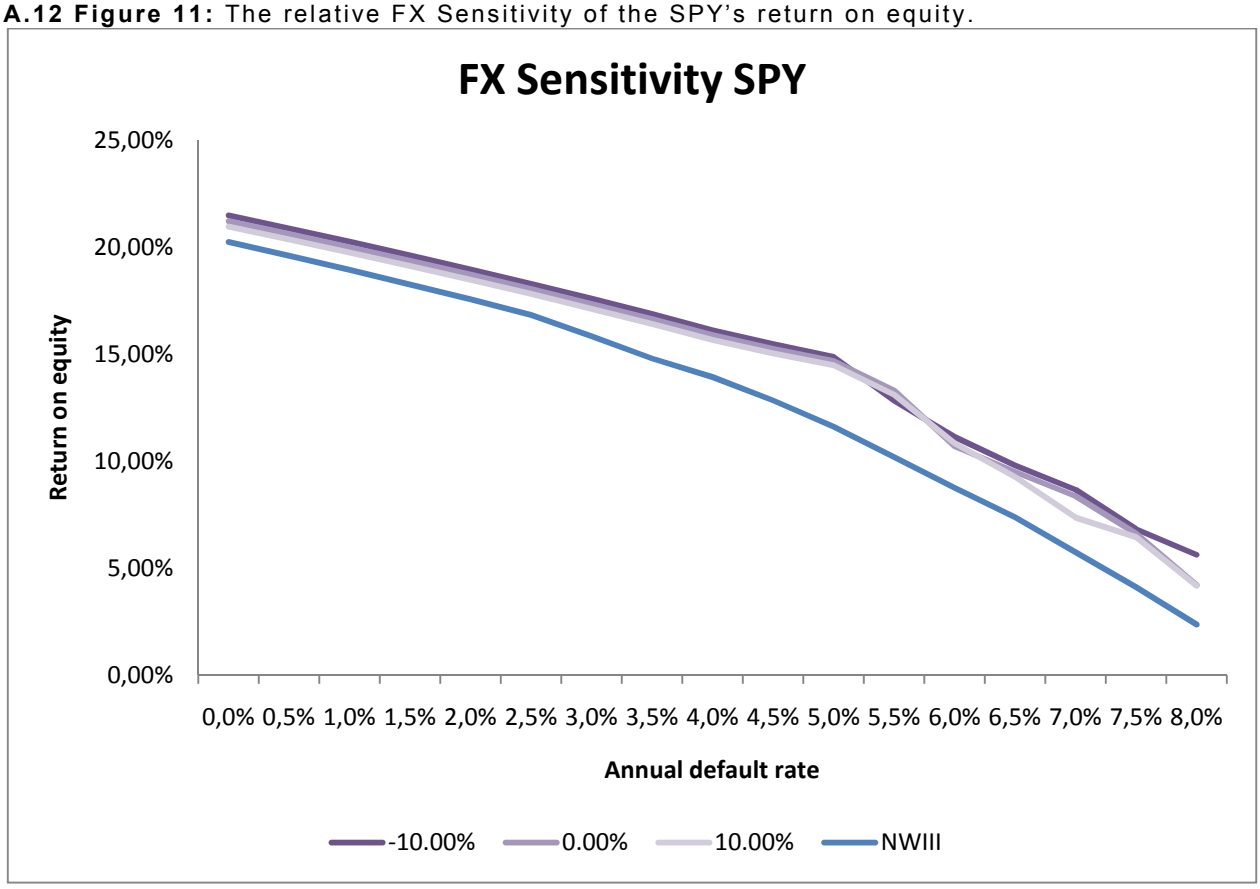
A.12 Figure 10: The relative LIBOR Sensitivity of the SPY's return on equity.



A.12 Table 10: The relative LIBOR Sensitivity of the SPY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
LIBOR Interest Rate Curve	-1%	20.11%	18.87%	17.56%	16.16%	14.66%	13.42%	9.12%	6.72%	2.49%
	0	21.24%	20.01%	18.73%	17.36%	15.91%	14.69%	10.70%	8.38%	4.21%
	1%	22.37%	21.17%	19.91%	18.57%	17.16%	15.96%	12.28%	9.98%	6.79%

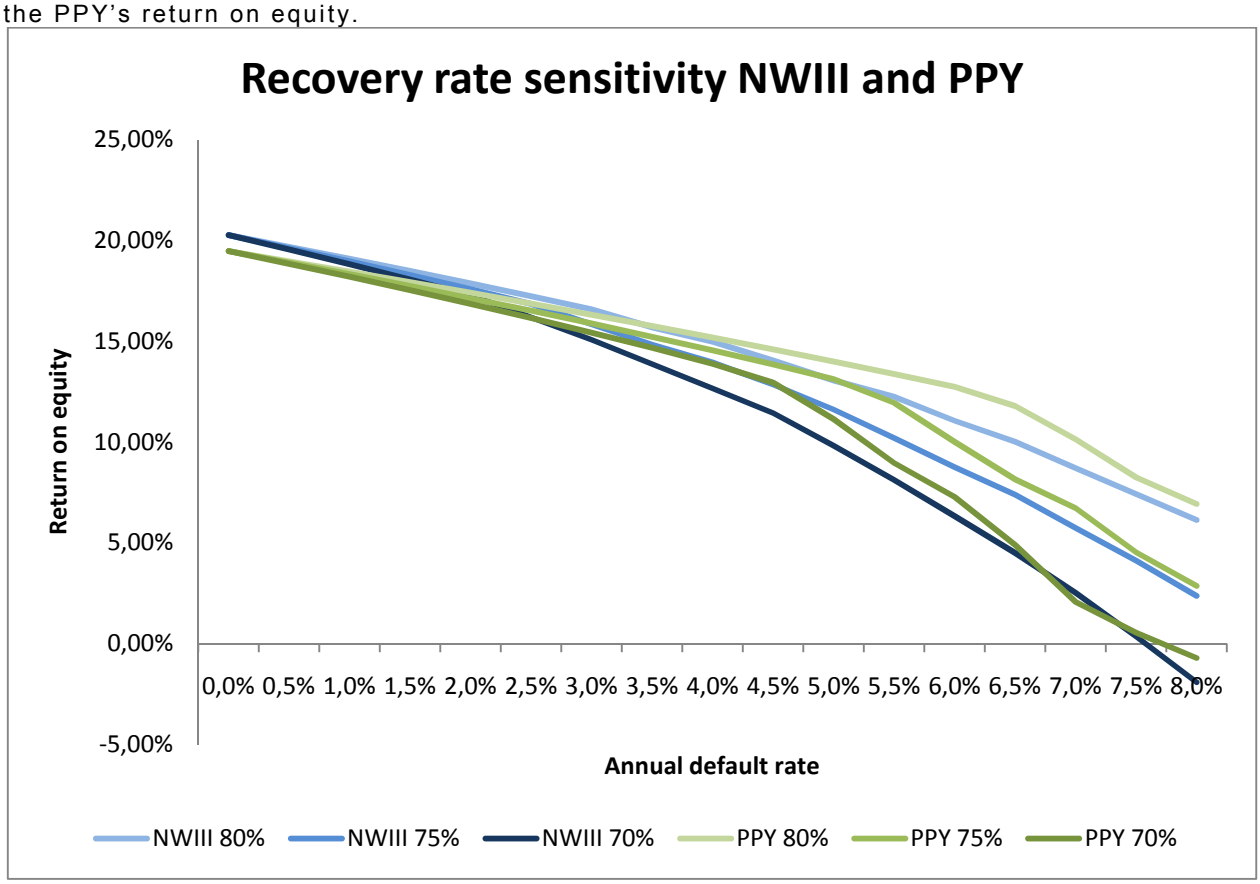
A.12 Figure 11: The relative FX Sensitivity of the SPY's return on equity.



A.12 Table 11: The relative FX Sensitivity of the SPY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
FX Curve	-10%	21.51%	20.27%	18.98%	17.61%	16.14%	14.89%	11.14%	8.67%	5.63%
	0	21.24%	20.01%	18.73%	17.36%	15.91%	14.69%	10.70%	8.38%	4.21%
	10%	20.99%	19.76%	18.49%	17.14%	15.69%	14.49%	10.84%	7.36%	4.18%

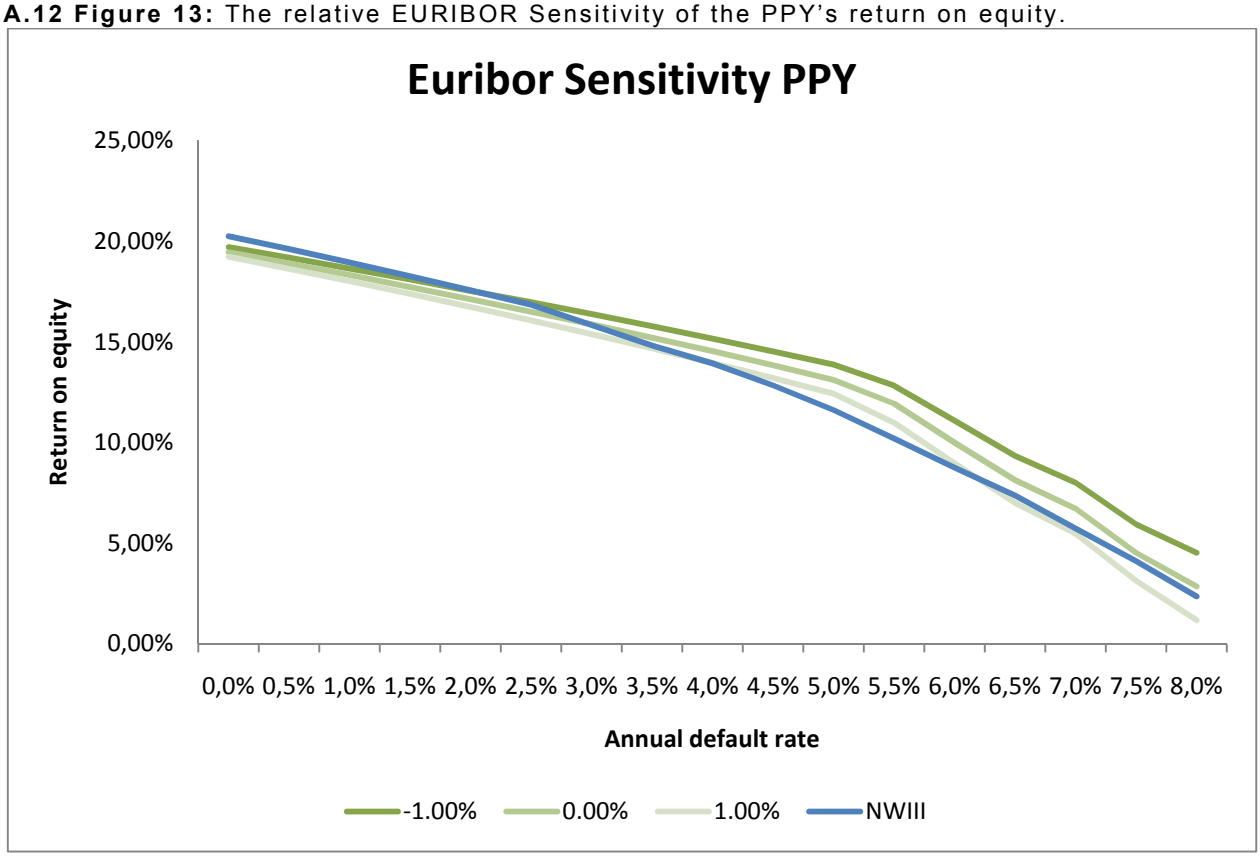
A.12 Figure 12: The relative Sensitivity to changes in the recovery rate assumptions of the PPY's return on equity.



A.12 Table 12: The relative Sensitivity to changes in the recovery rate assumptions of the PPY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
Recovery rate	80%	19.47%	18.46%	17.40%	16.32%	15.18%	13.99%	12.73%	10.14%	6.93%
	75%	19.47%	18.33%	17.13%	15.88%	14.55%	13.13%	10.00%	6.73%	2.86%
	70%	19.47%	18.19%	16.85%	15.42%	13.88%	11.14%	7.27%	2.06%	-0.71%

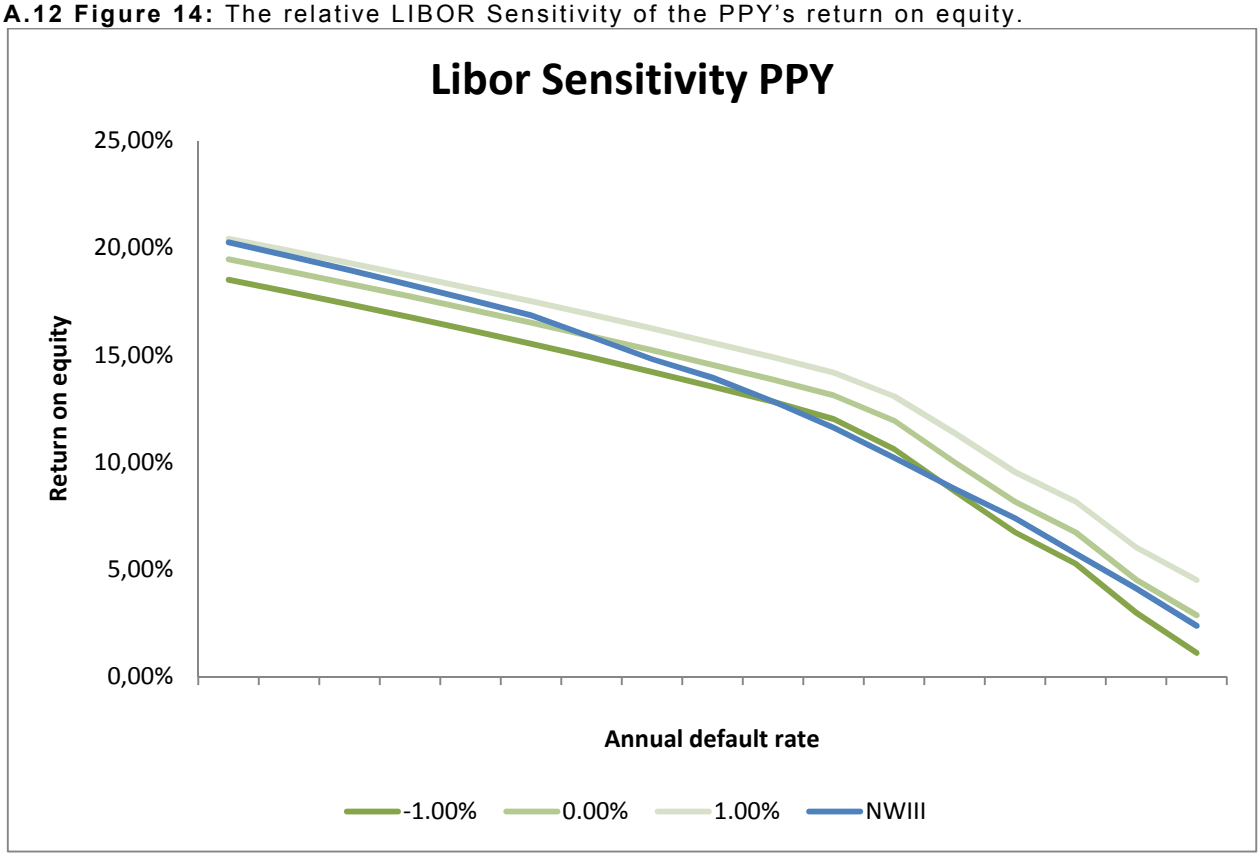
A.12 Figure 13: The relative EURIBOR Sensitivity of the PPY's return on equity.



A.12 Table 13: The relative EURIBOR Sensitivity of the PPY's return on equity.

Annual default	rate	0%	1%	2%	3%	4%	5%	6%	7%	8%
Shift Interest Rate Curve	-1%	19.71%	18.65%	17.55%	16.39%	15.17%	13.88%	11.10%	8.02%	4.53%
	0	19.47%	18.33%	17.13%	15.88%	14.55%	13.13%	10.00%	6.73%	2.86%
	1%	19.24%	18.02%	16.74%	15.40%	13.97%	12.43%	8.96%	5.49%	1.18%

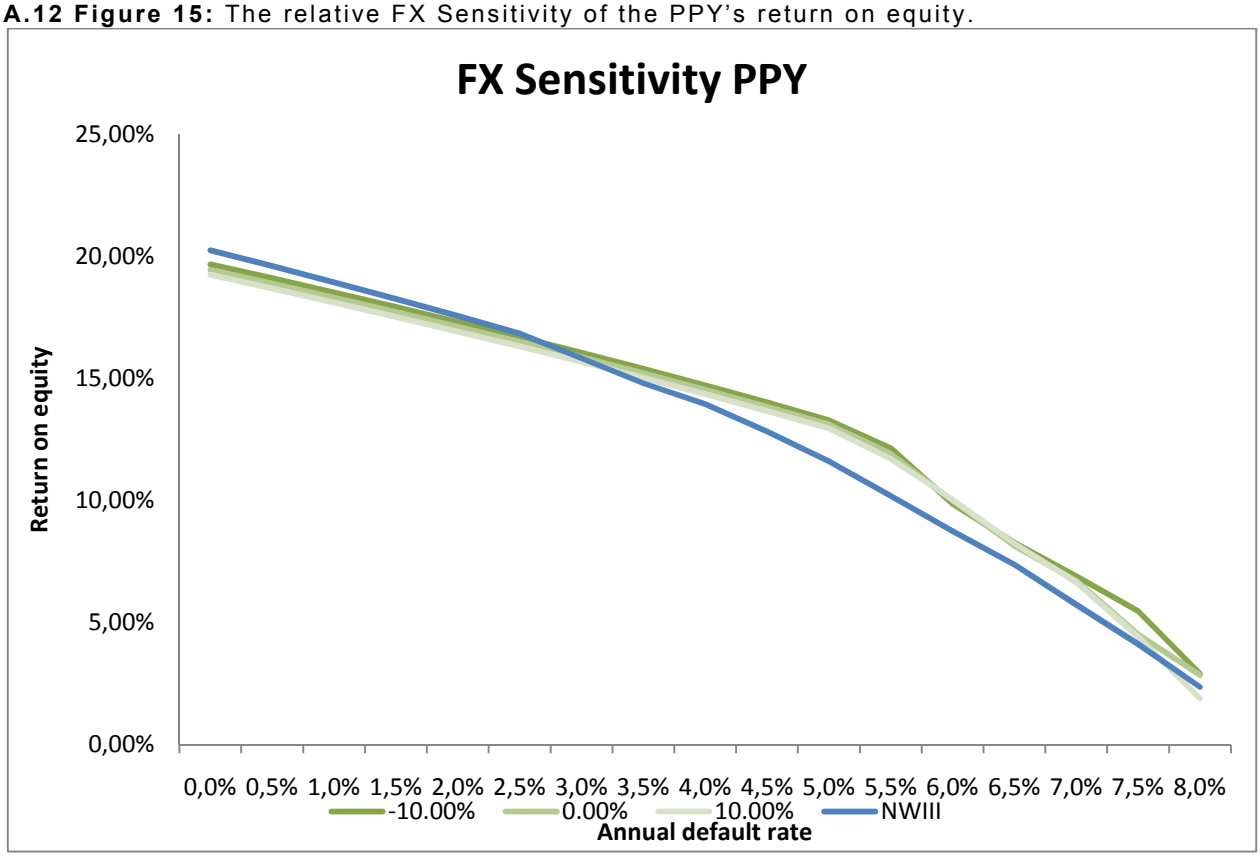
A.12 Figure 14: The relative LIBOR Sensitivity of the PPY's return on equity.



A.12 Table 14: The relative LIBOR Sensitivity of the PPY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
LIBOR Interest Rate Curve	-1%	18.52%	17.36%	16.15%	14.88%	13.53%	12.02%	8.64%	5.27%	1.10%
	0	19.47%	18.33%	17.13%	15.88%	14.55%	13.13%	10.00%	6.73%	2.86%
	1%	20.42%	19.29%	18.11%	16.88%	15.58%	14.19%	11.36%	8.17%	4.50%

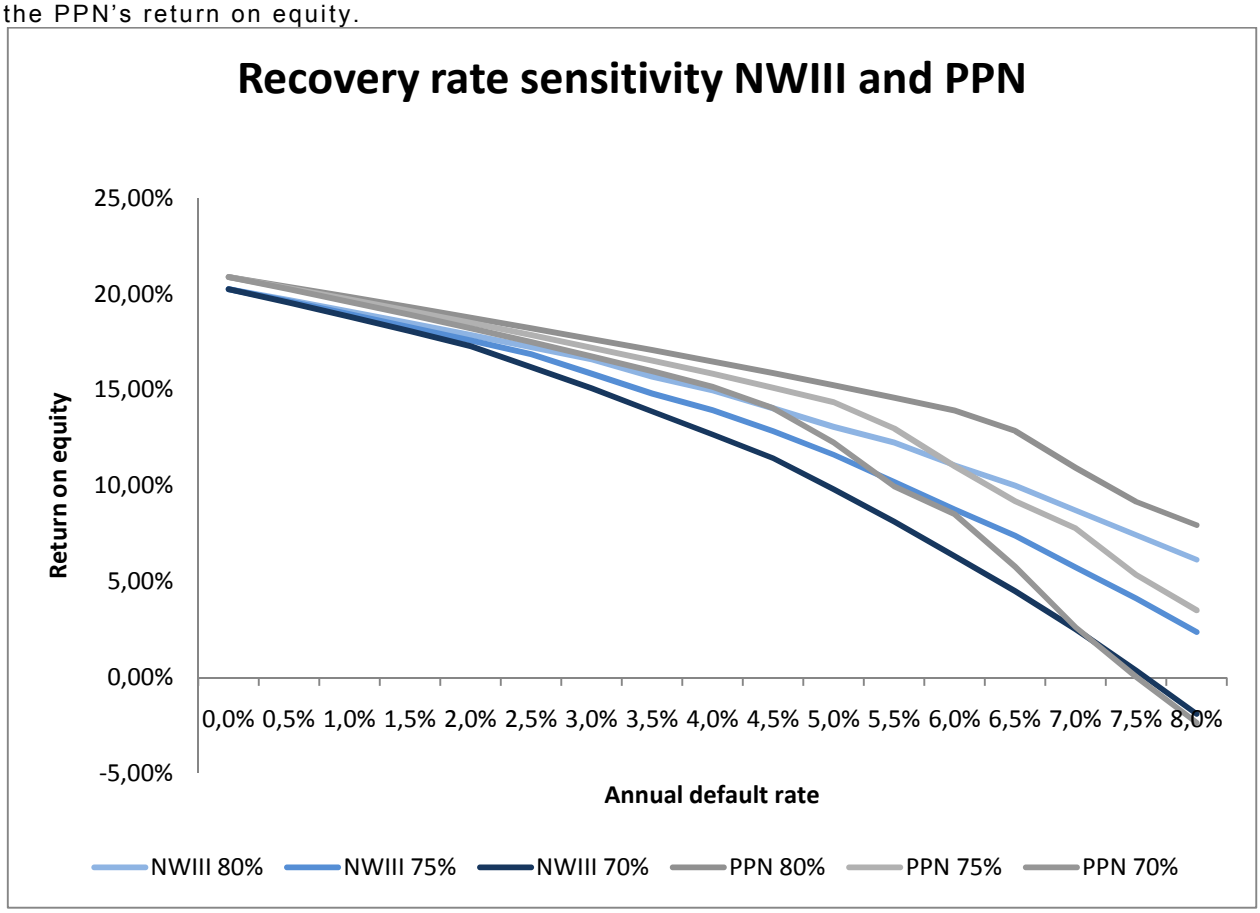
A.12 Figure 15: The relative FX Sensitivity of the PPY's return on equity.



A.12 Table 15: The relative FX Sensitivity of the PPY's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
FX Curve	-10%	19.69%	18.53%	17.33%	16.07%	14.73%	13.30%	9.89%	6.91%	2.93%
	0	19.47%	18.33%	17.13%	15.88%	14.55%	13.13%	10.00%	6.73%	2.86%
	10%	19.26%	18.12%	16.94%	15.70%	14.37%	12.96%	10.04%	6.66%	1.90%

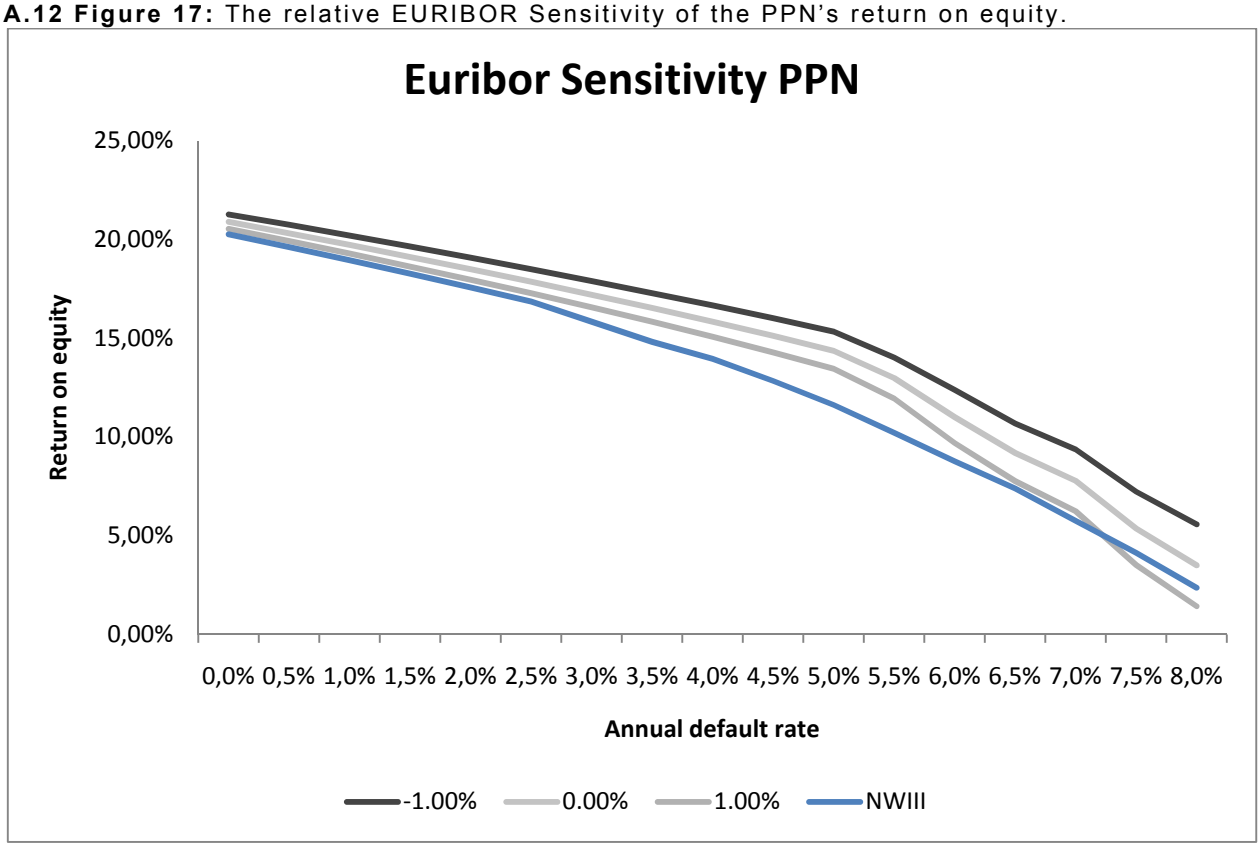
A.12 Figure 16: The relative Sensitivity to changes in the recovery rate assumptions of the PPN's return on equity.



A.12 Table 16: The relative Sensitivity to changes in the recovery rate assumptions of the PPN's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
Recovery rate	80%	20.9%	19.9%	18.8%	17.7%	16.5%	15.2%	13.9%	10.9%	8.0%
	75%	20.9%	19.7%	18.5%	17.2%	15.8%	14.4%	11.0%	7.8%	3.5%
	70%	20.9%	19.6%	18.2%	16.8%	15.2%	12.3%	8.5%	2.6%	-2.4%

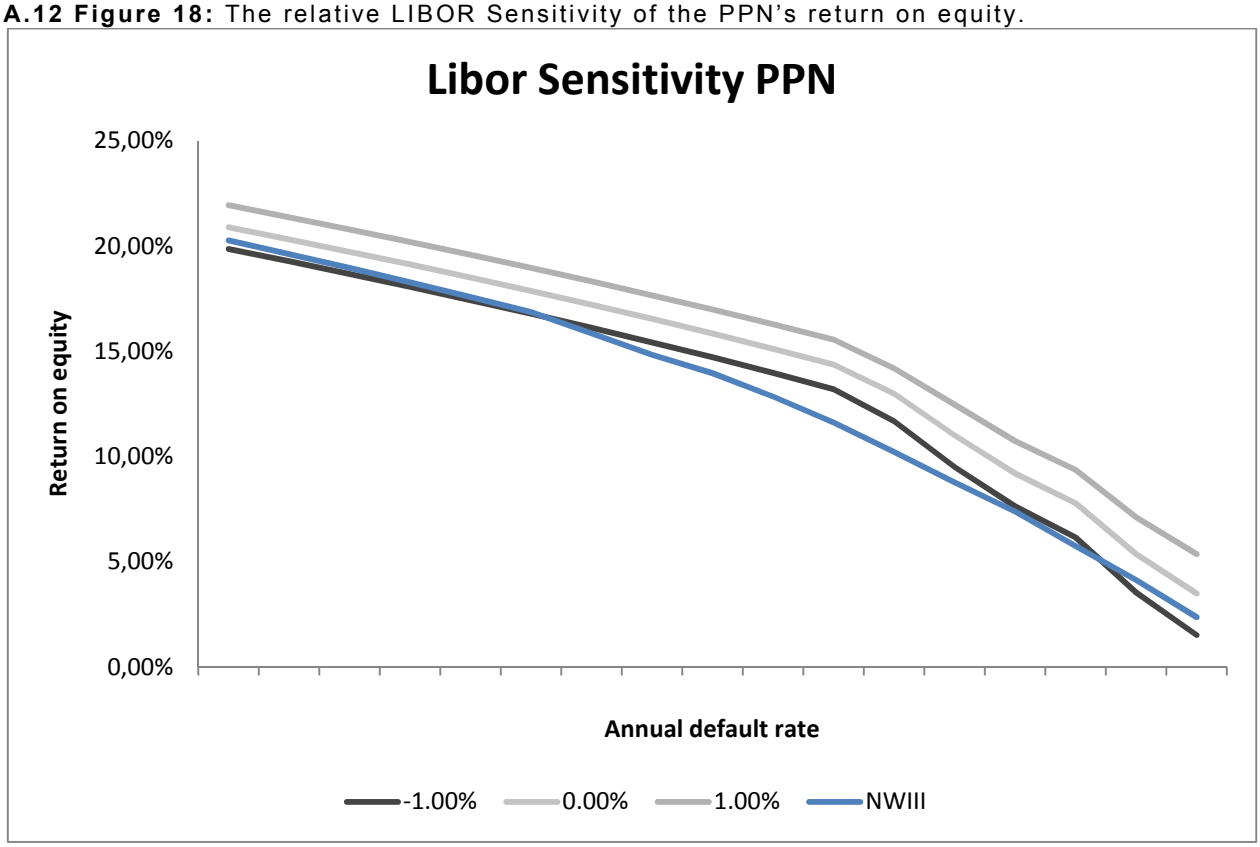
A.12 Figure 17: The relative EURIBOR Sensitivity of the PPN's return on equity.



A.12 Table 17: The relative EURIBOR Sensitivity of the PPN's return on equity.

Annual default	rate	0%	1%	2%	3%	4%	5%	6%	7%	8%
Shift Interest Rate Curve	-1%	21.3%	20.2%	19.1%	17.9%	16.7%	15.3%	12.4%	9.4%	5.6%
	0	20.9%	19.7%	18.5%	17.2%	15.8%	14.4%	11.0%	7.8%	3.5%
	1%	20.5%	19.3%	18.0%	16.6%	15.1%	13.5%	9.7%	6.2%	1.4%

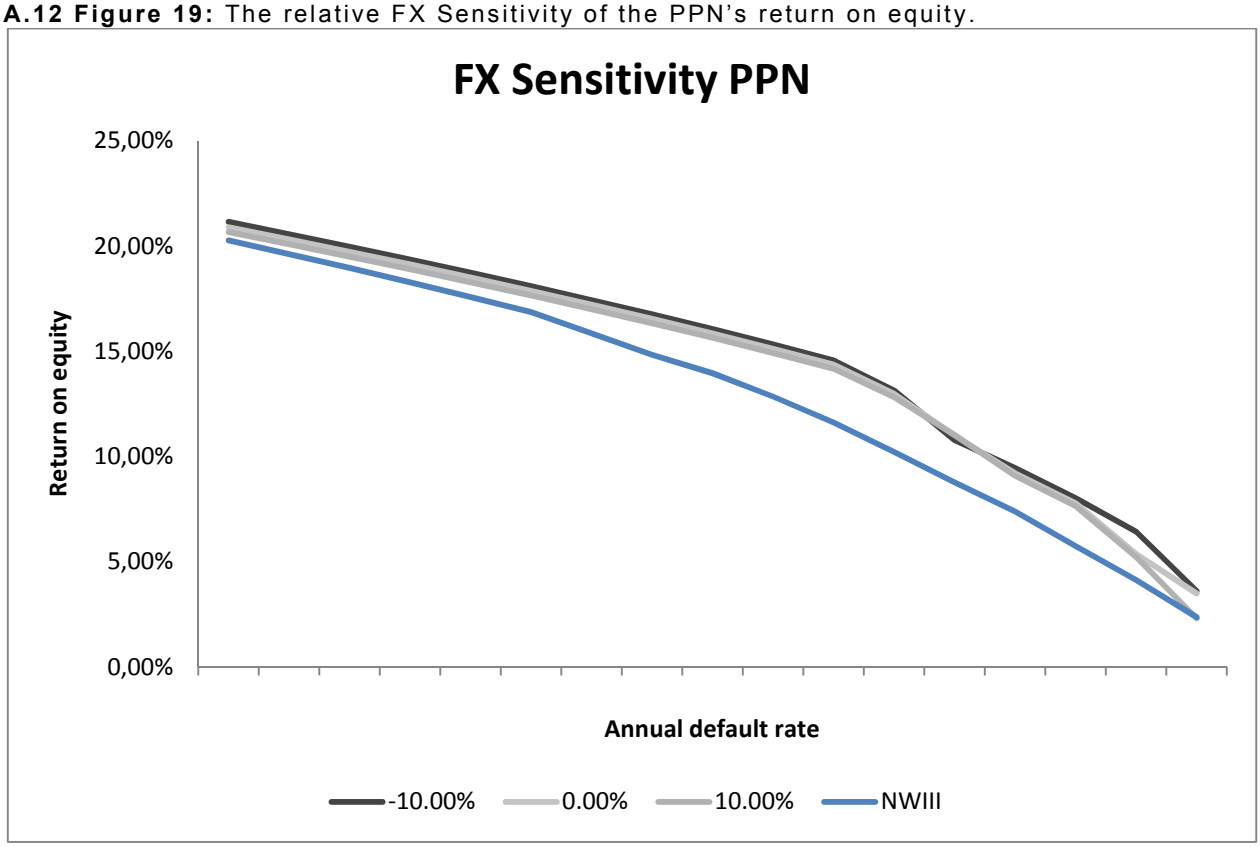
A.12 Figure 18: The relative LIBOR Sensitivity of the PPN's return on equity.



A.12 Table 18: The relative LIBOR Sensitivity of the PPN's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
LIBOR Interest Rate Curve	-1%	19.9%	18.7%	17.4%	16.1%	14.7%	13.2%	9.5%	6.1%	1.5%
	0	20.9%	19.7%	18.5%	17.2%	15.8%	14.4%	11.0%	7.8%	3.5%
	1%	21.9%	20.8%	19.6%	18.3%	17.0%	15.5%	12.5%	9.4%	5.4%

A.12 Figure 19: The relative FX Sensitivity of the PPN's return on equity.



A.12 Table 19: The relative FX Sensitivity of the PPN's return on equity.

Annual default rate		0%	1%	2%	3%	4%	5%	6%	7%	8%
FX Curve	-10%	21.1%	20.0%	18.7%	17.4%	16.1%	14.6%	10.8%	8.0%	3.6%
	0	20.9%	19.7%	18.5%	17.2%	15.8%	14.4%	11.0%	7.8%	3.5%
	10%	20.7%	19.5%	18.3%	17.0%	15.6%	14.2%	11.0%	7.6%	2.3%