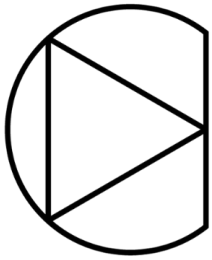

CAPTOR

Historical returns from rolling CDS index contracts

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Abstract

The purpose of this paper is to analyze historical returns from being long risk on rolling CDS index contracts. 20 years of data is examined for different CDS indices. Historical returns between roll periods are considered and are decomposed into carry, roll down and credit loss (residual) in order to analyze return contributions. From this data a number for the residual is solved. This number can further be used as a proxy for the expected credit loss in carry-roll down analysis and in ALM studies. Note that the credit loss/residual include spread movements.

The result shows for the past two decades an average per annum return of 1.14% for iTraxx Main with carry 0.80% and roll down 0.50% with residual -0.15%. For iTraxx Xover the average per annum return was 5.75% with carry 4.11% and roll down 1.32%. The residual was shown to be positive for Xover at 0.33%.

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Chapter 1

Introduction

1.1 History and characteristics

Synthetic CDS indices have been around for more than 20 years now. They originated in 2002 by JP Morgan and later Morgan Stanley launched their indices. The firms merged their indices in 2003 as TRAC-X and at the same time iBoxx created their own synthetic CDS indices. TRAC-X and iBoxx merged to form the today well known CDX indices in North America and the iTraxx indices in Europe and Asia. Today the indices are part of S&P Global since 2022. For further info see [1]. The most liquid indices are:

- iTraxx Europe index (commonly referred to as iTraxx Main), investment grade
- iTraxx Xover index, high yield
- CDX North America Investment Grade Index (commonly referred to as CDX IG)
- CDX North America High Yield index (commonly referred to as CDX HY)

There has been a process of standardization over the years but in 2009 came the so called "Big Bang" which had a large impact on the CDS market. Some examples of today's characteristics of CDS indices:

- Standard fixed coupons: 100bp for IG and 500bp for HY
- Standard maturity dates: either June or December
- Standard coupon paying dates: 20th of March, June, September and December
- Full first coupon and adjusted in upfront

- Rolled in March and September
- Credit events are processed by the Credit Derivatives Determinations Committee (DC)[1].
- Defaults are cash settled based on the auction result[2]

1.2 Trading volumes

Volumes in CDS instruments increased steadily up to the financial crisis in 2009. After then a series of major changes took place such as mandatory clearing, reporting requirements and standardizations. In [2] they show that between 2007 and 2017 outstanding notionals declined from $61 trillion to $9 trillion. This decline was however driven by compression. It should be noted that one needs to be careful when analyzing trends in outstanding notionals when this can be driven by increased clearing, netting and in this case compression. Also, from a trading perspective outstanding notionals only give a small indication of the market liquidity. Daily trading volumes would give better indications and even better when daily trading volumes are measured in DV01 instead of notionals.

Over time the liquidity started to concentrate to primarily indices and fewer instruments[3]. Since 2014 volumes in the CDS market has continued to decline but is driven by lower volumes in single name CDS. Index volumes have remained steady and also increased substantially during the COVID-shock in 2020[4]. Tradeweb reported a record roll volume in September 2024 when EUR 306bn was traded over 3 days[5].

CDS indices have become extremely liquid instruments in today's credit market, figure 1.1 shows historical traded volumes for some of the key indices. It can be noted that close to 100% of volumes are cleared in this period[6]. For the purpose of this analysis of rolling major CDS indices the liquidity will not pose any significant problems. This conclusion is based on the underlying liquidity data and also from the authors experience in trading these instruments. It should be noted that the liquidity is concentrated to the 5y tenor, it is mentioned in [3] that 5y tenor comprises 95% of volumes even though no source is mentioned.

[1] The process can be followed on `www.cdsdeterminationscommittees.org`.

[2] Auction results can be followed on `www.creditfixings.com`.

[3] In 2019 the four major indices mentioned previously together with iTraxx Europe Senior Financials comprised 90% of index volumes shown in [4].

[4] See [3] for further reading.

[5] Source: `www.tradeweb.com`

[6] Due to clearing obligation for indices this high number would be expected.

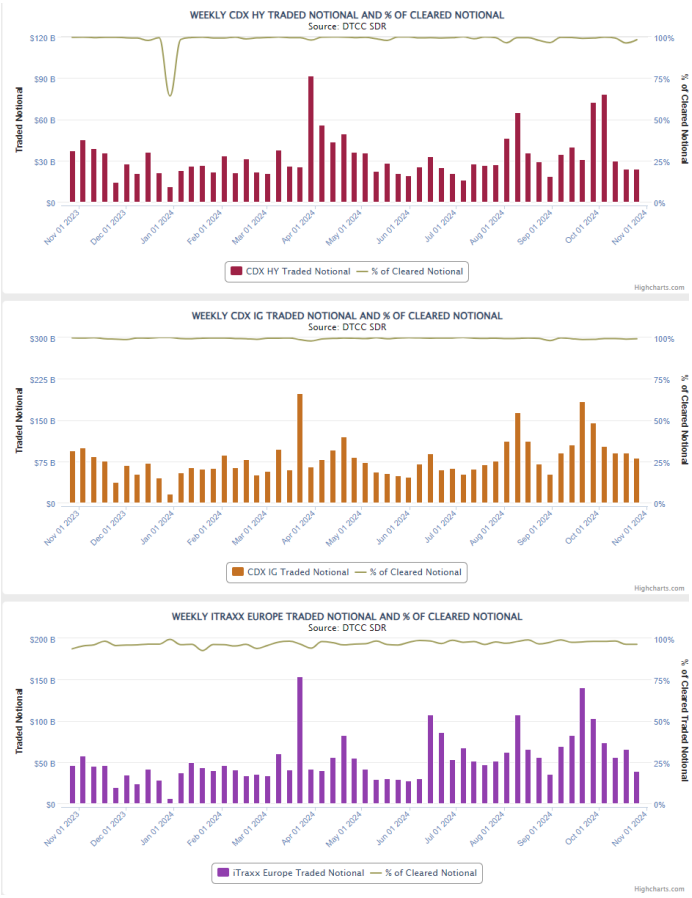

Figure 1.1: Historical trade volumes, source: `www.swapsinfo.org`

1.3 Composition

Each index is composed of underlying single name CDSs. At inception of an index the most liquid names, and other certain criteria, in each rating category is selected to compose the index. Table 1.1 shows the number of names in each index as of the specified series. This also means that the composition between series can be substantially different and one has to be careful when comparing series.

Picture 1.2 shows the name changes for iTraxx Xover rolling from series 41 to 42. One of the iTraxx market makers estimated the basket impact (impact from name changes) to 26bp and the six-month maturity extension at 10bp. Note the large difference in spread between the series due to the basket impact. This also give an indication that in a positive market climate names will migrate towards investment grade and be replaced by new riskier names. It is rare that

Index	Series	Constituents	Coupon (bp)
iTraxx Main	42	125	100
iTraxx Xover	42	75	500
CDX IG	43	125	100
CDX HY	43	100	500

Table 1.1: Indices with details.

iTraxx Europe Series 42 Final vs. Series 41 Changes

Sector / Index	Ticker	Reference Entity	IN / OUT	Comment
Crossover	CMACGM	CMA CGM	IN	
Crossover	CPIPRO	CPI Property Group	IN	
Crossover	OPTICBI	Optics Bidco S.p.A.	IN	
Crossover	EUTESA	Eutelsat S.A.	IN	
Crossover	TEAMSPA	TeamSystem S.p.A.	IN	
Crossover	PACHBID	Pachelbel Bidco S.P.A.	IN	
Crossover	ROSSSA	Rossini S.a r.l.	IN	
Crossover	ZEGONFI	ZEGONA FINANCE PLC	IN	
Crossover	ALSTOM	ALSTOM	OUT	
Crossover	CELLTEL	Cellnex Telecom, S.A.	OUT	
Crossover	GKNHOL	GKN HOLDINGS LIMITED	OUT	
Crossover	NFRAWIR	Infrastrutture Wireless Italiane S.p.A.	OUT	
Crossover	INTERNC	International Consolidated Airlines Group, S.A.	OUT	
Crossover	NOVAFIV	NOVAFIVES	OUT	
Crossover	ROLLS	ROLLS-ROYCE PLC	OUT	
Crossover	STONPUAD	STONEGATE PUB COMPANY FINANCING LIMITED	OUT	

Figure 1.2: Name changes Xover series 42, source: IHS Markit

the total spread change between series is negative even though it sometimes happens when names close to default are removed.

Chapter 2

Methods

All formulas outlined in this chapter are from the perspective of an investor being long risk/selling protection on the index CDS.

2.1 Return representation

The return, R, is represented as

$$R = carry + rolldown + residual \tag{2.1}$$

The return period is between the roll dates (semi-annual). Carry and roll down will be described in section 2.3. These variables can be estimated from a snapshot from current market conditions whereas the residual is the possible credit losses from each name in the index. When rolling the position every 6 month the credit losses would in many cases not be credit events but spread widening/rating migration instead, especially for investment grade where credit events rarely happen. The return representation above is without fees and transaction costs. This will be covered briefly with numeric examples in section 2.4.

2.2 Historical returns

Returns are estimated from semi-annual historical data between roll dates. The return is calculated as

$$R = uf_{t+1} + (\text{cash flows between t+1 and t}) - uf_t \tag{2.2}$$

where cash flows include coupons and credit losses and uf is the CDS upfront. uf is given by below (assuming no accrued interest)

$$uf = (C - S_p) \cdot PV01 \tag{2.3}$$

where C is the running coupon, S_p is the par spread and $PV01$ is the risky duration[1].

Formula 2.2 assumes no re-balancing during the 6 months investment horizon which in reality would mean that the trade is put on at time t and left until $t+1$. The notional of the trade is the base for the percentage return. One other option would be to consider the price to form a hypothetical bond with value $1+price$. When the returns are calculated between reset dates no consideration to accrued interest is needed.

2.3 Return contributions

Carry on an investment is the profit obtained by simply holding the investment. For a bullet bond it would be the yield on the bond minus the financing cost of holding the bond (either collateralized or not). For an unfunded instrument, like a CDS index, there is no initial cash investment (except for the initial margin if applicable) then the carry would simply be the quoted CDS spread. When standardized index CDS is not traded at par spread this is slightly different which is formalized below.

Carry will be calculated as ex-ante, this means based on the estimated values on the start date in each period. This would be the same as the calculation one would do to estimate future carry. This variable will not include realized credit losses but this will appear in the residual instead as outlined in section 2.1.

Ex-ante carry can be defined by

$$carry = \sum C \cdot \Delta t + (S_p - C) \cdot (\text{PV01}_{t_0} - \text{PV01}(S_p \text{ at } t_0)_{t_1}) \tag{2.4}$$

where $PV01$ is the risky duration at time t calculated with CDS spread S_p.

An alternative is to use the CDS spread implied by the roll down as

$$carry = \sum C \cdot \Delta t + (S_p - C) \cdot (\text{PV01}_{t_0} - \text{PV01}(S_p \text{ at } t_0 \text{ adj. for rd})_{t_1}) \tag{2.5}$$

This would also imply that the magnitude of the roll down would affect the magnitude of the carry. At the same time the value of par spread is affecting PV01, high par spread means lower PV01. The main reason for introducing the adjusted risky PV01 is to limit the risk of adding bias to the result.

Formula 2.6 shows one representation of calculating the ex-post carry. This would mean realized carry where losses from credit events are included.

$$carry = \sum C \cdot \Delta t + (C - S_p) \cdot (\text{PV01}_{t_0} - \text{PV01}_{t_1}) - \text{credit losses} \tag{2.6}$$

The re-valuation of an investment from time passing by and credit spread changing is the roll down. In credit markets credit curves are most often upward

[1] Also known as risky annuity which is the survival probability weighted sum of discount factors. Further use in this paper is defined in formula 2.12

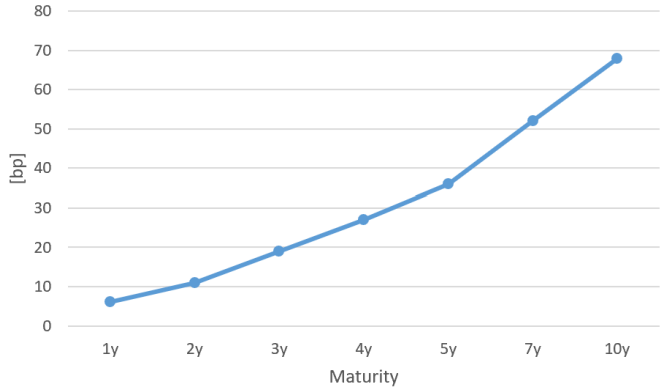

Figure 2.1: CDS curve for an example single name.

sloping (unless in distressed scenarios) which means when time is moving credit spreads are coming down. See for example figure 2.1 for a typical investment grade single name CDS. Considering the roll down in fixed income space is an integral part of investment decisions and is often a significant part of the performance.

In order to estimate the roll down one has to use the existing traded instruments available in the market. For some liquid names a full curve can be established but for other only a few points are available. In general the 5y point would hold most liquidity and in many cases other points trade with wide bid-offers. In this paper the focus will only be on the quoted levels on the specific CDS index and no consideration will be taken to underlying single name curves. CDS indices are traded in tenors of 3y, 5y, 7y and 10y. For the purpose of estimating the roll down for example for the 5y CDS then only the 3y CDS point is considered. See figure 2.2 for the CDS curve for iTraxx Main. Several single names in the indices has CDS curves at least covering the 4 year point and these show a linear change in time for the CDS spread. This would indicate that there would not be much curvature in the CDS curve for the index and would limit potential errors.

For analysis purposes one can compare different series to evaluate the 6 month difference. However, this must consider the differences in names between the series which can substantially differ as mentioned in section 1.3. Keep in mind that the roll down estimation is given the prevailing market condition and is not an observable realized value.

The present value of ex-ante roll down can be defined by

$$rd = \frac{S_{M_1} - S_{M_2}}{M(S_{M_1}) - M(S_{M_2})} \cdot (t_1 - t_0) \cdot PV01(S_p \text{ at } t_0)_{t_1} \tag{2.7}$$

where S is the par spread with maturity M, t_0 is the time at the beginning of the period in years, t_1 is 6 month later at the next roll date and M is the

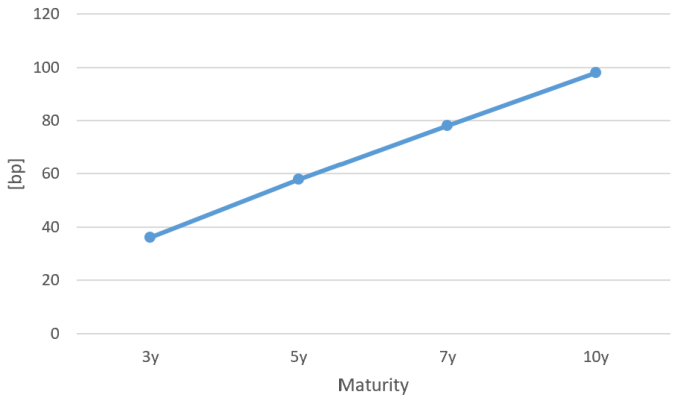

Figure 2.2: CDS curve for CDS index

maturity in years for the specific contract.

For the example of applying calculations to the 5y contract then M_1 will be the 5y contract and M_2 will be the 3 year contract. An alternative is to use the CDS spread implied by the roll down as

$$rd = \frac{S_{M_1} - S_{M_2}}{M(S_{M_1}) - M(S_{M_2})} \cdot (t_1 - t_0) \cdot PV01(S_p \text{ at } t_0 \text{ adjusted for roll down})_{t_1} \tag{2.8}$$

The following formula shows calculation of the present value of ex-post roll down

$$rd = \frac{S_{M_1} - S_{M_2}}{M(S_{M_1}) - M(S_{M_2})} \cdot (t_1 - t_0) \cdot PV01(S_p \text{ at } t_1)_{t_1} \tag{2.9}$$

The roll down calculated with formula 2.9 would be affected by the CDS spread in the end of the period due to the relation to PV01. If CDS spread would spike in the end of the period then the roll down would be much lower due to the lower PV01.

2.4 Transaction costs

There are several transaction costs involved in trading CDS indices. As mentioned in section 1.2 close to 100% of volumes in CDS index trading is cleared. This means in order to trade one has to setup a clearing broker with all the operations needed around it in terms of collateral management, reporting and administration. Executing brokers need to be in place and a trading platform needs to be setup. In terms of running costs the following are highlighted:

- Bid/offer spread

- Clearing broker fees
- Financing cost on instrument/cash posted as initial margin
- Clearing house fees

Table 2.1 shows the estimated transaction cost for each index category based on estimations from Captor Fund Management. These numbers can further be used to adjust return estimations.

CDS index	Transaction cost (per annum)
Investment grade	1 bp
High yield	5 bp

Table 2.1: The table shows estimated transaction costs.

2.5 Data set

Historical data for iTraxx Main and iTraxx Xover since series 2 starting in September 2004 is used in this analysis. The reason for starting with series 2 and not series 1 is due to non-overlapping data on the roll date for series 2 for unknown reason. Daily data is available but only the data for the semi-annually roll dates is considered. For the purpose of this analysis when dividing return periods into roll dates only semi-annual data is needed. The 20 years of data will generate 40 return periods. Figure 2.3 and 2.4 shows the historical on-the-run par spread for the indices. Notice that each data point will hold data both for the on-the-run CDS index and the previous series but in the figures only the on-the-run is visible.

The data quality is in general assumed to be very high when it comes from the owner (Markit/S&P Global) of the indices. The data is particularly rich starting from 2012 including several data points such as default probability, jump to default risk and DV01 both for credit and interest rate. There is some uncertainty for the data for the earliest series mostly due to the non-standardization of that time and also lack of some data. Another change is that risky PV01 is not included in the data set until 2012 which is needed for this analysis. In order to calculate PV01 some assumptions need to be made and it would have been beneficial to have risky PV01 data available for the entire historical period.

In the Markit data only versions changes are available, actual default data is not. Credit events and recovery values have been compiled by the author from various sources. The key source has been `www.creditfixings.com`.

There exists indices calculated by Markit/S&P Global since 2007, both in excess return and total return version. These indices are daily rebalanced and therefore differs in strategy compared to the approach in this paper. Most

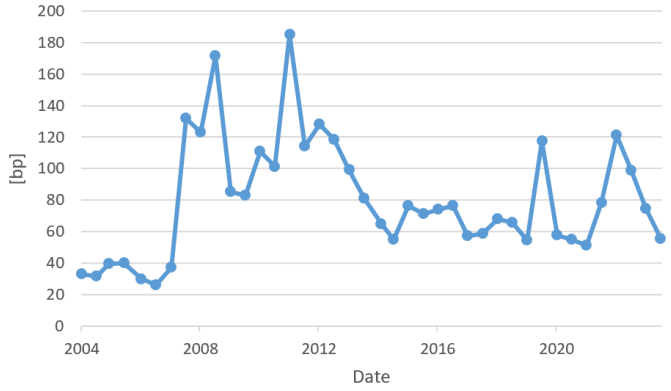

Figure 2.3: Historical spread for iTraxx Main

Figure 2.4: Historical spread for iTraxx Xover

versions of the indices also include roll transaction costs[2]. However, in order to validate the underlying data in this report these indices have been used. Particularly for credit events and recovery values.

Besides for par spread the historical data from Markit/S&P Global contains several useful fields for this analysis. Such as:

- Upfront (as *price* starting from 2005-03-16)
- Running coupon
- Risky PV01 (starting from 2012-03-20)

For the periods when required fields are not available these are calculated from available market data. Notice that when above fields are available only

[2]For more information see iTraxx/CDX Total and Excess Return Index Calculus published by S&P Dow Jones Indices

very simple calculations are needed as example the formulas 2.5, 2.7 and 2.3. For iTraxx Xover the 3y CDS par spread was not available until 2008 and therefore an estimate was made for the 3y CDS par spread during this period. The estimate was made by calculating the average of the difference between 3y and 5y CDS when it was available. And further apply this value to the prevailing 5y CDS par spread to reach the 3y CDS par spread.

2.6 CDS formulas

In this paper only simplified calculations are applied in order to not need calibration of interest rate curves etc. Most needed data is already available in the given data set but data for risky PV01 outlined in for example formula 2.5 is required. Below formulas are derived and outlined in [5].

Risky PV01 is the sum of the probability of survival adjusted discount factors. Using the assumption of constant hazard rate, λ, it can be defined as

$$\lambda = \frac{S_p}{1 - R} \tag{2.10}$$

where R is the assumed recovery rate[3]. This formula is sometimes referred to as the "credit triangle". With the assumption of constant hazard rate the survival probability can be written as

$$Q(t) = e^{-\lambda t} \tag{2.11}$$

The risky PV01 can then be written as

$$\text{Risky PV01} = \sum_{i=1}^{M} \Delta_i \cdot P(t_i) \cdot \left(\frac{Q(t_{i-1}) + Q(t_i))}{2} \right) \tag{2.12}$$

where P is the discount factor, Δ the year fraction and i the coupon period up to total M periods.

[3]There is a market standard for recovery rate assumptions for the major CDS indices for the purpose of calculations.

Chapter 3

Results

In the previous chapter there were several formulas outlined for calculating carry and roll down. The approach chosen will be based on the ex-ante convention where values are estimated based on the information known at the beginning of each period. This would assume the model where if the CDS spread would end up at the expected roll down value then the residual in formula 2.1 would be zero. This would mean that the formula 2.5 would be used for carry and formula 2.8 for roll down. The liquidity is concentrated to the 5y CDS as discussed in 1.2 and therefore this tenor is the target investment instrument in this analysis.

3.1 Historical realized returns

The first series started 2004-09-20 and the last full period series ended 2024-09-20. Returns for each period was calculated and is depicted in picture 3.1 for iTraxx Main and in 3.2 for iTraxx Xover. These are ex-post realized returns from the semi-annual rolling periods, not annualized in order to show the actual returns. Returns are split in the picture depicted in the bars as carry, roll down and residual. There are a few deep downturns, for example in period 9 (2008) for iTraxx Xover, but are often followed by a recovery in the following period.

3.2 Return contributions

Picture 3.3 shows the annualized historical ex-ante carry for iTraxx Main and picture 3.4 for iTraxx Xover. These values follow the same pattern as the historical par spread but calculated with formula 2.5. The pictures also show the average value in dotted line. The carry was significantly lower for iTraxx Main in the period up to the financial crash in 2008, spreads have never been that low again. Note that daily levels for par spreads have fluctuated more than the semi-annual points visible in these graphs. Also note that movements in the graphs also include potential basket impact between series and maturity extension.

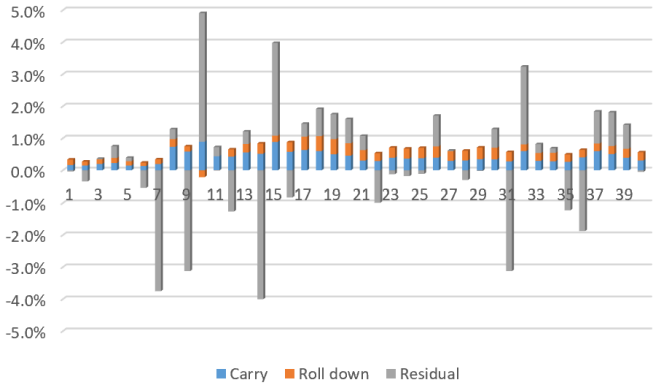

Figure 3.1: iTraxx Main periodic returns

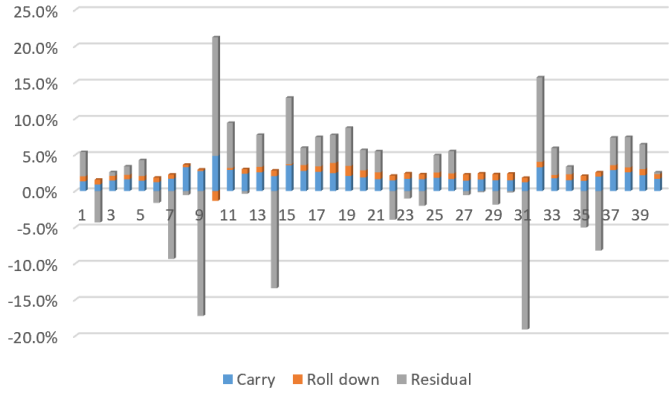

Figure 3.2: iTraxx Xover periodic returns

Picture 3.5 shows the annualized historical the ex-ante roll down for iTraxx Main in terms of return for the 6 month period. The roll down has been relatively stable since 2015. During the financial crisis in 2009 the curve became inverted and showed a negative ex-ante roll down based on the 3y and 5y CDS. Picture 3.6 shows historical the ex-ante roll down for iTraxx Main in terms of spread together with the roll for each series in order to give an overview of the historical changes.

Picture 3.7 shows the annualized historical ex-ante roll down for iTraxx Xover in terms of return for the 6 month period. As can be seen in picture 3.7 the ex-ante roll down has been relatively stable for most of the historical period. The roll down for Xover is not as large as for Main in relation to the spread level. The liquidity in the 3y point for Xover is much less than the 3y point for Main which could cause a faulty estimation of the roll down for Xover.

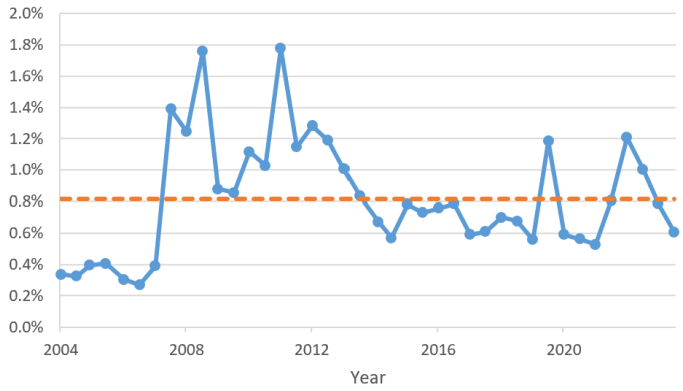

Figure 3.3: iTraxx Main historical ex-ante carry

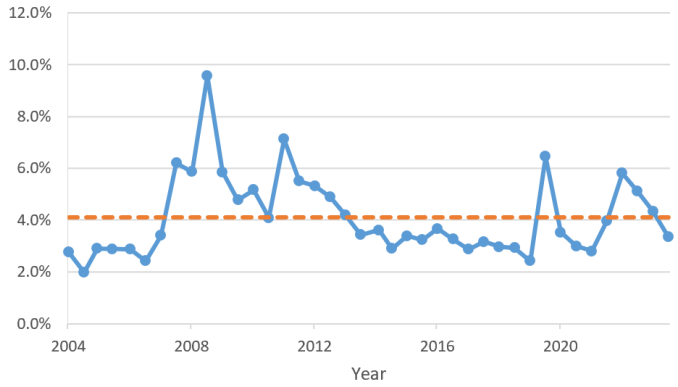

Figure 3.4: iTraxx Xover historical ex-ante carry

Picture 3.8 shows historical the ex-ante roll down for iTraxx Xover in terms of spread together with the roll for each series in order to give an overview of the historical changes. The series roll is visualizing the spread change when a new series starts. It has varied a lot and is caused by the higher volatility of high yield names. Both in terms of credit improvements and names becoming distressed. As mentioned in section 1.3 names changes between series for Xover can sometimes have a large impact, both from distressed names being removed from the index and also names migrating to investment grade and being replaced by high yield names.

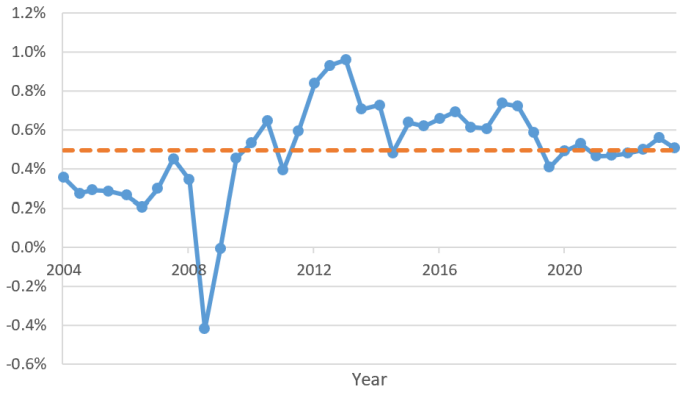

Figure 3.5: Ex-ante roll for for iTraxx Main in terms of return.

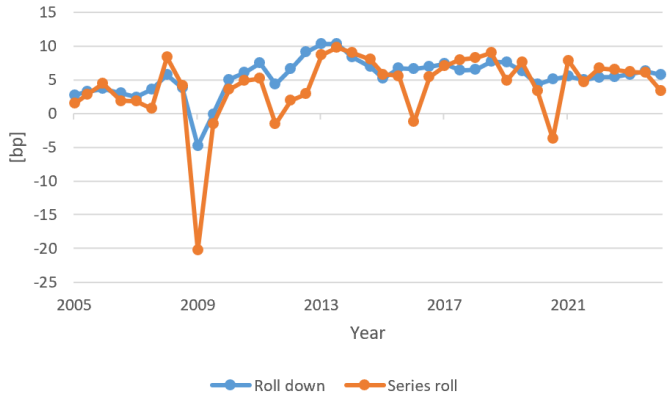

Figure 3.6: Ex-ante roll for for iTraxx Main and the roll for each new series.

3.3 Average values

Table 3.1 shows the average values for iTraxx Main. An adjusted residual is also calculated to reduce effects of temporary swings in CDS spreads. The calculation is simply performed by evaluating the annualized mark-to-market effect from the start CDS spread in the first period and the end CDS spread in the last period. In this dataset this effect was rather small but take the example if the end CDS spread had spiked during a turmoil, it would have affected the residual value substantially. Note that for name changes between series, which would alter the risk significantly, this adjustment could be erroneous. However, for the purpose of adjusting for potential spikes this could be accepted. It should be highlighted that the residual should be seen in relation to carry and roll down to be correctly represented.

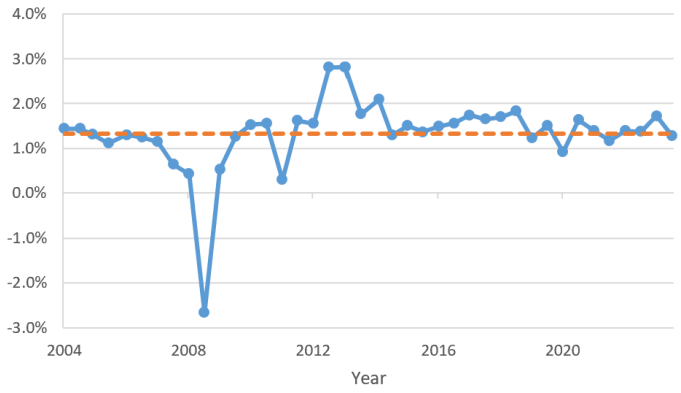

Figure 3.7: Ex-ante roll for for iTraxx Xover in terms of return.

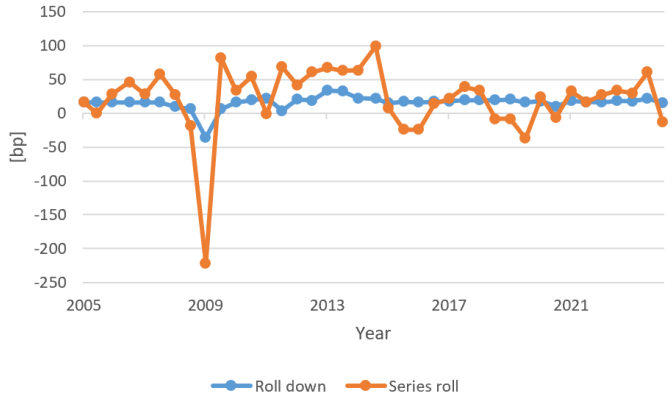

Figure 3.8: Ex-ante roll for for iTraxx Xover and the roll for each new series.

Return	Carry	Roll down	Residual	Adj. Residual
1.14%	0.80%	0.50%	-0.15%	-0.11%

Table 3.1: iTraxx Main average values.

Table 3.2 shows the average values for iTraxx Xover. Note the positive value for the residual. This means that during the 20 year period there were a positive return contribution from the added credit risk instead of losses. This can be assumed to be strongly linked to the economic development and as a reference, during the same period, MSCI World Net total return (USD) went up 410%, 8.5% annually.

It can be seen in picture 3.8 that during the years 2011 to 2015 it was a very strong credit performance and where new series came constantly at a higher spread than expected from the roll down estimation from the curve steepness.

This very strong period affected the residual value significantly. The methodology of how names are added and replaced will obviously be a significant factor for the performance.

Return	Carry	Roll down	Residual	Adj. Residual
5.75%	4.11%	1.32%	0.33%	0.31%

Table 3.2: iTraxx Xover average values.

Table 3.3 shows average numbers in terms of spread for the holding period of approximately 6 months. Par spread means the par spread on each roll date. Spread change shows how the spread has changed between each period, a positive numbers means a spread widening. Roll down is the ex-ante roll down and a positive number should be interpreted by an expected *lower* spread. The series roll is how much *higher* the new series was compared to the previous.

Index	Par spread	Spread change	Roll down	Series roll
Main	80 bp	-3.5 bp	5.5 bp	4.1 bp
Xover	396 bp	-18.3 bp	16.1 bp	19.0 bp

Table 3.3: Indices average par spread, spread change, roll down and series roll.

Chapter 4

Conclusion

The result from this analysis gave a broad picture of the historical returns from several CDS indices. The characteristics of returns were substantially different between investment grade and high yield indices. Roll down was a significant part of the return for investment grade but a smaller part for high yield. On the other hand when looking at the residual this was as could be expected, negative only for investment grade, but not for for high yield. Even though the term of data was relatively long the actual data points was more limited, 40 data points for 20 years of time series. This could give a very good overall picture of returns but might be too limited to draw strong conclusions for expected values. This would be particularly applicable to the residual for iTraxx Xover, would it be prudent to expect the residual to be positive over time? In a market climate when we have seen almost double digit percentage returns on the equity market for a very long time it is not unreasonable.

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