The Danish Market for Principal Protected Notes

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May 15, 2009

Abstract

In this paper we study the pricing of principal protected notes sold to retail investors in Denmark in the period from 1998 to 2008. We estimate the total cost asscociated with each note in order to see whether these notes are reasonable priced or not. We find the average total cost for a principal protected note is...and futhermore we find that..... We then run regressions to see whether some of the note specific characteristics can explain the total cost. We find that.....

1 Introduction

From an academic perspective principal protected notes are a very intriguing but also a puzzling type of financial asset. These notes have received a lot of negative attention from both the press and academics but still retail investors keep buying them in large numbers. In 2007 and 2008 there were issued structure products for respectively 233.2 billion and 208.2 billion euro in Europe[1]. So even in spite of the financial crises the market is rather active. Some of the largest countries, within Europe, in terms of gross sales are Germany, Italy, Spain and Switzerland. On the opposite side of this scale there is Norway where the banks are no longer allowed to sell complex financial assets to retail investors.

The motivation for the paper is to shed some light on the actual costs paid by investors when they invest in principal protected notes. Since the price of these notes are solely determined by the issuer/organiser, and not by the market as for most other financial assets, one would be tempted to assume that there are significant costs to be paid by the investor. We therefore estimate the total costs as the difference between the issue price and the "fair" value a principal protected note.

Having estimated the total cost for each note we try to explain the total cost by running OLS regressions with total cost as the dependent variable and

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[1] SPRMagazine.com - www.structuredretailproducts.com

some note characteristic dummy variables as explanatory variables. In order to motivate the choice of variables to use in the regressions we first test for differences in the average total cost within each dummy variable.

Mispricing have been shown in previous studies, for instance in Rasmussen (2007) [3], Stoimenov & Wilkens (2005) [4], and Burth, Kraus & Wohlwend (2001) [1]. All of these studies base their conclusions on only a few notes or on a broader class of structured products. In this paper we focus only on principal protected notes. Our analysis will be based upon a data set consisting of 341 principal protected notes that where issued to Danish retail investors in the period from 1998 to 2008. The large number of notes in our sample should give robust results.

In the next section, the term principal protected note and the process of issuing such a note is described. Section 3 presents our data set. Section 4 gives a broad descriptive analysis of the Danish market for principal protected notes. Section 5 describes our method for the analysis of the costs/pricing and the empirical results of our analysis are presented in section 6. The final section 7 summarizes and discusses further areas for research.

2 Principal protected notes and the agents in the market

In this section we define what we mean by principal protected notes and describe the process for issuing notes.

A principal protected note is a compound financial product which consist of two elements: the first is a simple bond (bullet loan)[2] often a zero-coupon bond, and the second element is an option written on some underlying asset. From an overall perspective the structure of the notes seem to be fairly identical but the variation in choice of option and underlying asset makes the notes highly heterogenous (see section 4).

This type of product is appealing to the retail investor since the zero-coupon bond provides a protection of the principal while the option gives an upside potential. Though it seems like you are able to get the best from the two worlds - an upside potential without any risk! If nothing else these features will at least make it easier to sell the notes to retail investors.

The typical payoff structure for a principal protected note is shown in equation (1) where P is the principal, PR is the participation rate and OP is the option payoff.

$$Payoff = P + P \cdot PR \cdot OP \tag{1}$$

[2] In some cases the "secure" element is represented by an CDO which under the recent financial crises have proven not to be "secure" despite a (usually) high rating.

An specific example of a payoff function could be a note with a call option written on a stock index

$$Payoff = P + P \cdot PR \cdot \max\left(\frac{S_T - S_0}{S_0}, 0\right)$$

where S_0 is the initial value of the stock index and S_T is the value of the index at maturity.

The participation rate (gearing) represents the percentage at which the investor participates in the appreciation of the underlying asset. From a marketing perspective there is no doubt that the participation rate is an extremely important factor - the higher the better[3]. The problem is that the participation rate can easily be manipulated in order to make the note look more attractive in the eyes of the investor. So the point here is that notes cannot be compared based on their participation rate. The participation rate should be viewed in connection with the type of option and the specific underlying asset.

The process of issuing a principal protected note involves a number of different agents who of course all have an economic incentive to participate in the market. The *organiser* is the focal figure in the process. The organiser defines the "theme" that is the choice of underlying asset and the other features of the bond and the option. There is made arrangements with an *issuer* of the note. Principal protected notes are an alternative to raising capital e.g. in the regular bond market, so the issuer could in principal be any firm who wishes to raise new capital. A common characteristic for the issuers are that they are highly rated. The issuer is naturally looking for the cheapest funding at a known rate and therefore the obligation on the option element is often hedged through an *investment bank*. In principal this makes the investment bank the supplier of the option element which of course comes at a cost: either as an up-front lump sum or as a spread on the option price. Given that market conditions change constantly the final terms for the option cannot be settled before the subscription period is ended. This means that investors do not know the final terms of the note when they buy it[4]! Often there is no closed form formula to determine the price of the option so in order to get the best possible price the organiser request several investment banks to bid on the option element. Finally the product is sold through a *distributor*. In practice one agent might play more than one role, for example Nordea Bank may be both organiser, issuer, investment bank and distributor for a given note.

[3] Of couse this may not be the full story. A high participation rate can also be a part of the investment strategy behind the note; it may be better to have a high participation rate in an option with limited upside than having a low participation rate in an option with unlimited upside.

[4] In most cases it is the participation rate which is unkown until the end of the subscription period, but in some case it is the actual issue price which is unkown to the investor at the point in time where she or he signs the deal! In these case the investor only knows a range within the issue price may end up.

Table 1: For each note we have collected information regarding the 20 variables listed in the table

1	ISIN code	12	Participation rate
2	Name	13	Coupon size
3	Issue date	14	Option type
4	Expiration date		(categorized by "main" type)
5	Issuer	15	End date for the option
6	Issuer rating at the time of issue	16	Underlying asset (categorized)
7	Organizer	17	Number of underlying assets
8	Issue currency	18	Protection level
9	Nominal issue	19	Specific underlying assets
10	Issue price	20	Cost per year
11	Repayment price		

3 Data description

The data set consists of 347 principal protected notes issued from 1998 to March 2009. These notes are primarily sold to Danish retail investors and we estimate that the sample corresponds to approximately 80 - 90 percent of the total number of issues on the Danish retail market[5]. From 2002 and forward we believe that the data set almost replicates population data.

For each note we collected a copy the prospectus, factsheet, issue notices, and the repayment notices. The documents where mainly found on the webpages of organisers (banks) and the Nordic exchange (NASDAQ OMX Nordic) but in some case the relevant documents are provided on our request. Since the individual notes are not rated we have collected information regarding the rating of the issuer on the date of issue for the individual note. The ratings are specified as the rating from Moody's and they are collected from Bloomberg.

From this material we have extracted information regarding the 20 variables shown in table 1.

The following section presents a number of descriptive statistics based on the variables in table 1. The purpose is to gain insight into the size of the market and the diversification of the individual products. The analysis is based on full year samples that is the period from 1998 to 2008. All numbers are reported in Danish kroner (DKK) since this is the original currency. The exchange rate at the end of April 2009 for Euro and U.S. Dollar is respectively: 100 EUR $\approx$ 745 DKK and 100 USD $\approx$ 570 DKK.

[5] We would like to thank Anne-Sofie R. Rasmussen from the Danish Nationalbank who collected the first part of the data set.

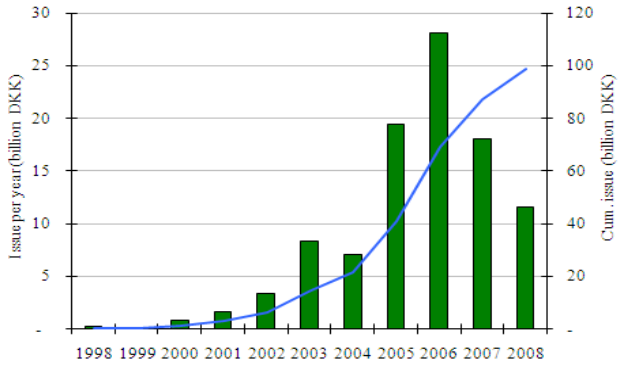

Figure 1: The figure shows nominal issues - measured in Danish kroner - over the sample period. The columns represent the nominal issue per year and the line represents the accumulated nominal issue.

4 Descriptive analysis of the Danish market

First we look at the size of the market which is illustrated by table 2 and by figure 1.

From Panel A in table 2 we see that there is a dramatic increase in the number of issues per year from 2000 to 2001 and that the yearly number of issues increases gradually over the following years. In 2006 there is issued 70 new notes which is the highest number of yearly issues. In the following years 2007 and 2008 the number of issues drops presumably as a consequence of the growing financial crises in these years. Over the entire period there is issued 341 notes of which 263 or approximately 75% are issued with a zero-coupon and 96 notes are issued with either a fixed or a floating coupon. Panel B of table 2 shows the maximum, minimum and average nominal issues per years. As for the number of issues there seems to be a trend for the maximum and the average nominal issue to increase until 2006 and thereafter it falls back.

Figure 1 shows the nominal amount issued each year and the cumulative amount issued from 1998 to 2008. We observe the same trend as in table 2, namely that there is an increase in the amount issued until 2006 and from there we see a drop in nominal amount issued per year. In 2006 - the record year - there where issued notes for approximately 28 billion DKK, and in total there has been issued notes for approximately 100 billion DKK from 1998 to 2008. Comparing with table 2 we can conclude that the dramatic increase in the value of the market is an effect of both an increase in the number of issues and the size of the individual issue.

Given the substantial size and rapid increase in market value it is of course interesting to look at the agents that participate. Figure 2 shows the market

Table 2: Panel A shows the number of issues per year. The first row shows the total number of issues and the second and third row shows the number of issues with a coupon or a zero-coupon as the bond element. Panel B to E shows the development in the maximum, minimum and average values of the nominal issue in Danish Krone per year, time to maturity measured in years, issue price and the direct costs per year which is stated in the prospectus. For the years 1998 to 2001 there is not enough available information regarding the direct cost per year

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	1998 - 2008
Panel A: Number of issues												
Total	3	1	6	15	19	40	33	44	70	61	49	341
Coupon	0	0	2	1	6	12	6	18	16	8	9	78
Zero-coupon	3	1	4	14	13	28	27	26	54	53	40	263
Panel B: Nominal Issues (million DKK)												
Maximum	75	127	177	210	927	792	681	2,416	3,044	1,570	1,148	3,044
Minimum	50	127	62	50	25	16	20	8	26	18	23	8
Average	63	127	135	119	176	208	214	442	402	296	237	290
Panel C: Time to maturity (years)												
Maximum	5.5	4.0	7.0	6.0	5.0	10.0	10.0	11.0	8.0	8.0	6.1	11.0
Minimum	3.0	4.0	3.0	2.0	2.0	2.0	0.8	0.8	1.0	0.6	0.5	0.5
Average	4.0	4.0	4.3	4.3	4.4	4.8	4.9	5.0	3.3	3.1	2.7	3.9
Panel D: Issue price (% point)												
Maximum	104.0	105.0	105.0	105.0	440.6	110.0	116.6	115.0	200.0	116.0	110.0	440.6
Minimum	100.0	105.0	100.0	100.0	75.0	76.5	100.0	88.0	98.1	100.0	100.0	75.0
Average	101.3	105.0	104.0	103.7	120.8	101.7	104.4	101.7	105.2	102.8	102.7	104.2
Panel E: Published cost per year (%)												
Maximum					1.65	2.48	1.80	1.43	2.00	2.33	1.95	2.48
Minimum					0.74	0.56	0.37	0.17	0.25	0.14	0.58	0.14
Average					1.17	1.09	1.04	0.80	1.04	1.06	1.07	1.02

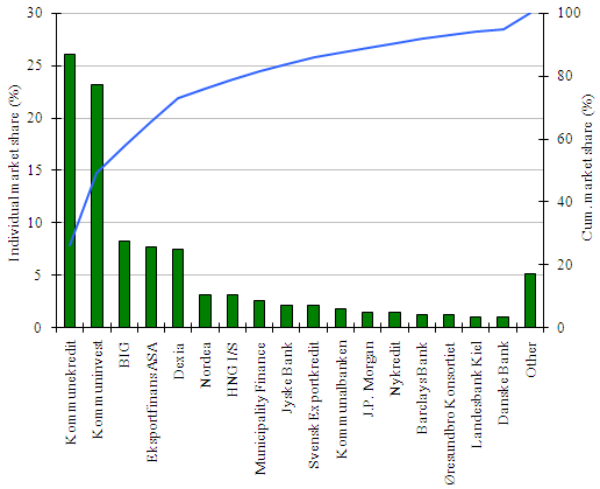

Figure 2: The columns represent the market share for individual issuers and the line represents the accumulated market share. Individual market shares are based on nominal values.

share for the individual issuer and the accumulative market share. The first thing we notice is that the market seems to be dominated by two very large issuers, KommuneKredit (26%) and Kommuninvest (23%). Both these companies are in the public sector, which is kind of surprising given the vast public criticism of these products. Following the two large issuers there is a group consisting of three issuers (BIG, Eksportfinans ASA, and Dexia) who each has a market share around 8%. The five largest issuers are behind more than 70% of the total nominal amount issued on the market.

The rating of the issuers shows that all are in the investment grade category and around 70% are in the highest (Aaa) category.

Figure 3 shows the market share for the individual organiser and the accumulative market share. The picture we see is surprisingly identical to the picture for the issuers. The market is dominated by two very large agents, followed by a small group of medium sized and finally a number of small organisers. The two largest organisers are not surprisingly the two largest banks in Denmark, namely Nordea (30%) and Danske Bank (24%). The second runner up is Garanti Invest (13%) who was the pioneer within principal protected notes in Denmark, and has this business as the sole activity.

With respect to market participants we can conclude that the market is highly dominated by a few large agents. Given this market structure and the complexity of the notes one may start to question the competitiveness of the market and thereby the efficiency of the pricing.

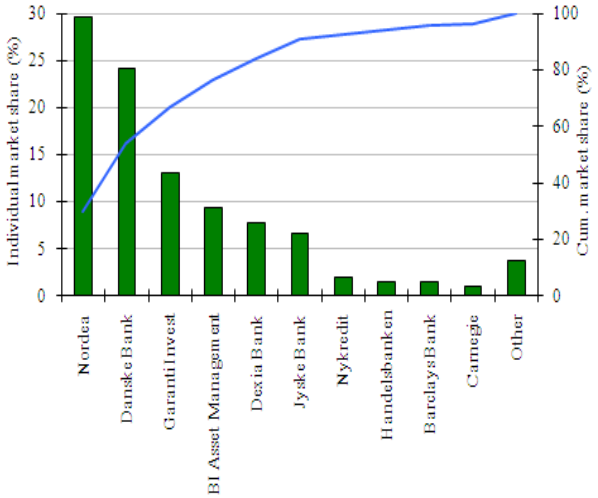

Figure 3: The columns represent the market share for individual organisers and the line represents the accumulated market share. Individual market shares are based on nominal values.

Looking at some of the key characteristics of the individual notes we get a glimpse of the wide diversification. Table 2 presents the maximum, minimum and average values for the years 1998 to 2008 for the *time to maturity* (Panel C) and the *issue price* (Panel D).

The time to maturity is important to both issuer and investor since a longer time to maturity causes the price of the zero-coupon bond to drop thereby leaving more money to buy options for and thereby increases the potential upside for investors. On the other hand a longer time to maturity means that investors need to tie up (given the poor liquidity in secondhand market) their invested money for a longer period and at the same time their possible loss of interest increases. From Panel C in table 2 we see that average time to maturity over the period is 3 to 5 years. In the last three years the average tend towards 3 years. The longest time to maturity is increasing until 2006 where after it goes a bit down. The shortest notes have a downward slopping trend throughout the period. Notes with a very long time to maturity is often coupon paying products with an additional option for the issuer to redeem the notes in some pre-specified special cases.

The issue price is the price that the investor pays for the note. The note is typically issued at a price above 100% of the nominal - e.g. 103% of the nominal amount - and the price is for most cases stated in the prospectus. Here it is important to notice that the value of the bond element and the option element may not add up to the 100% and thereby making the 3% premium equal to the cost for investor. There real cost to investor is exactly what we try to estimate

in section 6.

From Panel D in table 2 we see that the highest issue prices are in the range from 104 to 116 with a few exceptions in 2002 and 2006 where notes are issued at 440.6 and 200 respectively. A typical feature about the notes issued at high prices are that they are a "Super" version of a lower priced note. The two notes are identical except for the participation rate, which is higher for the "Super" note than it is for the "Normal" note. There is of course a cost to getting more upside potential, hence the higher issue price. For most years the minimum price is around 100, but again we see some cases where the issue price is below 100. The average issue price is in the range from 101 to 105 with the exception of 2002. This corresponds well with the fact that approximately 80% of the notes in our database are issued at a price within the range from 100 to 106 (not seen from the table).

As implied above not all notes in our database have a 100% principal protection. However, this is the case for approximately 90% of the notes whereas the remaining part has a principal protection in the range from 55% to 98%.

The participation rate is not shown in table 2 but still deserve a brief comment. As mention it can easily be manipulated which is also implied in the data where we find that the highest participation rate is 1285% and the lowest is 27%. The average is 148% and approximately one third of the notes have a participation rate in the rage from 100% to 130%.

As mentioned previously principal protected notes are often issued with some theme which is reflected in the choice of underlying asset for the option. Figure 4 illustrates the frequency distribution among different categories of underlying assets. The categories "*Stock index*" and "*Currency*" are by far the most used. One reason for this could be that it is relatively easy to find a specific asset within these categories that fit into the theme. The third largest category is "*Single share/index*" which covers notes with a single stock as underlying and notes with a basket of single stocks representing some industry, e.g. "Health Care" or "Finance", as underlying. In some cases you will also find interest rates, commodities or corporate bonds as the underlying.

Since "*Stock index*" and "*Currency*" represents such a large fraction we will investigate these two categories in greater detail. Figures 5 and 6 show how the two categories are distributed among different stock indices and currencies.

From figure 5 we see that Dow Jones' Euro Stoxx 50 (25%), Nikkei 225 (17%) and S&P500 (12%) are the most frequently used indices. Following the three largest we find Topix (6%), FTSE Xinhau China 25 (5%) and the Danish index OMXC20(4%). In most cases the principal protected notes have several indices as underlying and not just one, e.g. a basket consisting of Dow Jones' Euro Stoxx 50, Nikkei 225 and S&P500 which then represents a "global" index.

In figure 6 we see that the is a tendency for a few currencies to be used more frequently than others. In the top five we find Turkish Lira (TRY), Euro (EUR), Brazilian Real (BRL), US Dollar (USD) and Mexican Peso (MXN). Euros are

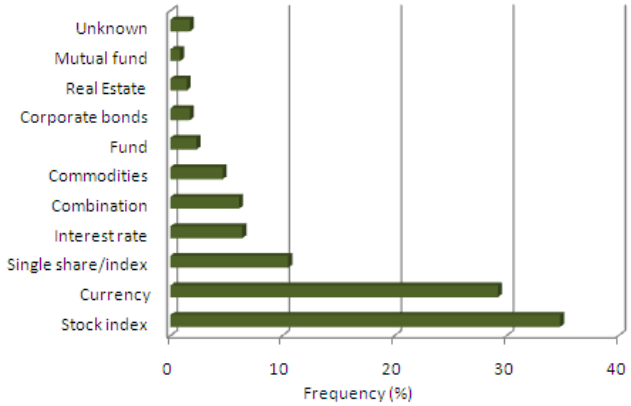

Figure 4: The figure shows the frequency distribution for the categories of underlying assets. The frequency is based on the number of issues.

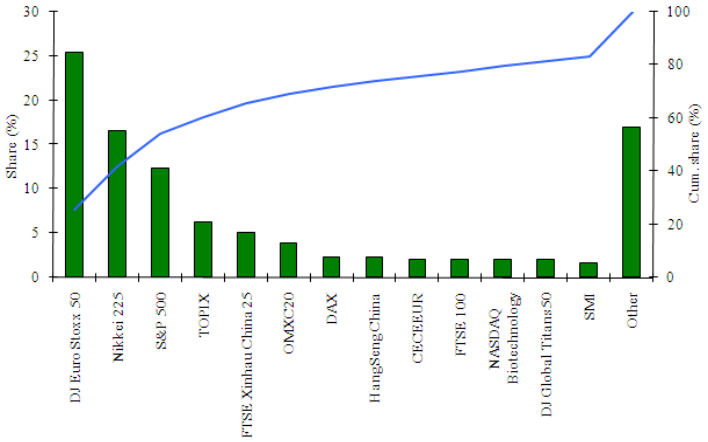

Figure 5: The columns represents the frequency for a specific index whereas the line represents the accumulative frequence. The frequencies are only based on the notes in the underlying asset category "Stock index".

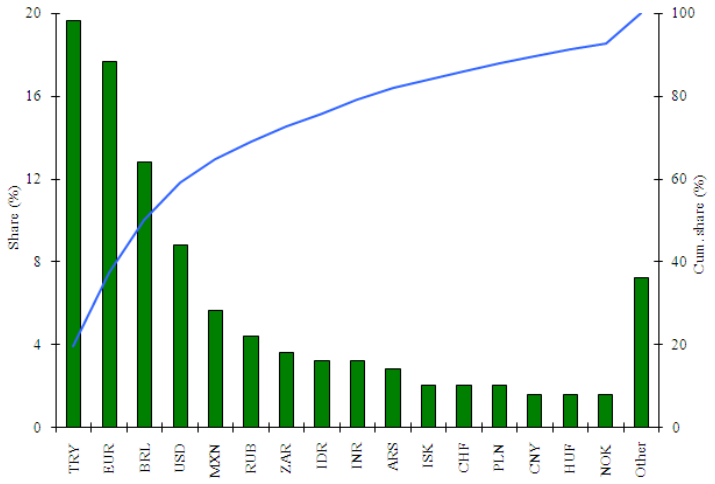

Figure 6: The columns represents the frequency for a specific currency whereas the line represents the accumulative frequence. The frequencies are only based on the notes in the underlying asset category "Currency".

often used as the base currency in the spread options which might explain the high frequency of the Euro. Following top five we find other "exotic" currencies such as Russian Ruble (RUB), South African Rand (ZAR), Indonesian Rupiah (IDR) and Indian Rupee (INR). The high frequency of various exotic currencies may be caused be several factors. Firstly, based on the often favorable development in the economy in these countries in the period previous to the issue the organiser may see these currencies as a good investment opportunity. Secondly, a less noble explanation may be that the interest rate often is relatively high in these countries. A high interest rate affects the option price negatively and thereby the participation rate positively. Thirdly, from a more "friendly" perspective the notes with exotic currencies as underlying could be viewed as an attempt to help retail investors execute carry trades in a protected environment. In some of these case one can argue that the principal protected notes expand the investment opportunities for retail investors since in practice it may be impossible or at least to expensive to gain access to investments in these countries.

The choice of option is crucial for the participation rate. The cheaper the option the more options you can buy and thereby increase the participation rate. The value of the option of course depend on the potential upside, so by cutting off some of the upside you get a cheaper option. There are several ways to do this, e.g. introducing a cap, an Asian element or by having a basket of underlying assets which have low correlation and thereby less volatility in the basket. Figure 7 shows the frequency for each option type we have observed in

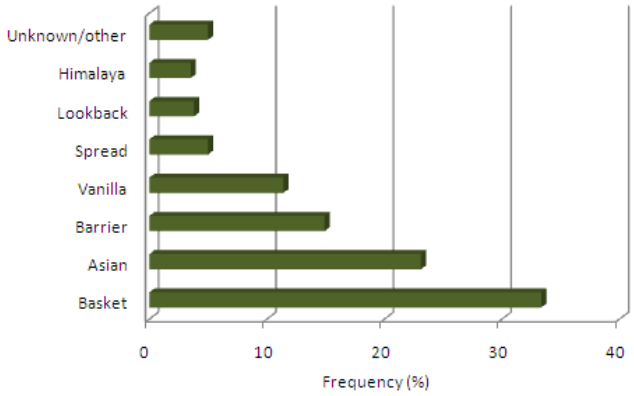

Figure 7: The figure shows the frequency distribution of the number of issues by main option category.

the data set. Often it is not possible to assign the notes to one specific option type since they have features from several different types. We have therefore tried to assign the notes according to their "main" category, but the figure shall be interpreted with this in mind.

As expected we see that the relatively cheap options show up in the vast majority of the notes. The most frequently used option type is the basket option (33%), secondly it is the pure Asian type (23%) and thirdly it is the barrier option (15%). As an example of the ambiguous categorisation it can be mentioned that 73% of the basket options have an Asian element and 31% of the Vanilla category has a cap element. Hence the diversification of the notes is greater than what is seen from figure 7.

5 Empirical methodology

There are two types of costs associated with principal protected notes. The first type is the direct costs that covers marketing, licenses, provision etc. These costs are naturally laid upon the investors, but since investors have no possibility to evaluate the magnitude of these costs, one would assume that the issuer/organiser will make sure to get at least enough to cover the actual cost. Panel E in table 2 shows the maximum, minimum and average published cost per year for the period 2002 to 2008. The average cost per year is constantly around 1% but looking at the maximum and minimum values we see that the cost per year deviates significantly in both directions. The second type of cost is the hidden cost which is connected to the pricing of the option, e.g. the fee to the investment bank, possible mispricing of the option etc.

We define the total cost for a specific note as the issue price minus the fair value of the bond and the option elements.

$$\text{Total cost} = \text{Issue price - (value of bond + value of option)}$$

This is not a direct measure for the mispricing of the notes since there of course are some costs associated with the engineering of the notes which should be paid by the investors. Then question is then whether these estimated *total costs* seems reasonable or not from the perspective of the investor.

Having estimated total cost it is of course of interest to see if there are any connection between note specific characteristics and the size of the total cost. We define six dummy variables for the note specific characteristics.

$$\begin{aligned}
Issuer &: \{1 = \text{Large}, 2 = \text{Medium}, 3 = \text{Small}\} \\
Organiser &: \{1 = \text{Large}, 2 = \text{Medium}, 3 = \text{Small}\} \\
Option &: \left\{ \begin{array}{c} 1 = \text{Basket}, 2 = \text{Asian}, 3 = \text{Barrier}, \\ 4 = \text{Vanilla}, 5 = \text{Spread}, 6 = \text{Lookback}, \\ 7 = \text{Himalaya}, 8 = \text{Other} \end{array} \right\} \\
Asset &: \left\{ \begin{array}{c} 1 = \text{Stock index}, 2 = \text{Currency}, 3 = \text{Single stock/index} \\ 4 = \text{Interest rate}, 5 = \text{Combination}, 6 = \text{Commodities}, \\ 7 = \text{Other} \end{array} \right\} \\
Time - to - maturity &: \{1 = < 3, 2 = [3\ ;\ 5], 3 = > 5\} \\
Issue\ year &: \{1 = 1998 - 2003, 2 = 2004 - 2008\}
\end{aligned}$$

For both issuer and organiser "Large" is defined as the two largest agents, "Medium" is defined as the third to fifth largest agents and "Small" covers the rest of the agents.

First of all it is interesting to test whether there are significant differences in average total cost within each of the variables, e.g. are there any differences among large, medium and small issuers. We test for differences in the average total cost by performing a simple t-test for differences in means, hence our hypotheses is

$$H_0 : \mu_{high} - \mu_{low} = 0$$

Secondly, it is interesting to see whether some of the note specific characteristics can explain the total cost variable. We test this by running OLS regressions with total cost as the dependent variable and some of the dummy variables as explanatory variables. The t-test from above can serve as an indicator for which variables we should use in the regression. If there is no significant difference among the entities in the variable then it seems unlikely that we will get significant coefficients in the OLS regression.

5.1 Calculating the fair price

In order to estimate the total costs we need to estimate the fair price of the bond and the option element.

All data regarding underlying assets, interest rates etc. are taken from Datastream.

5.1.1 Pricing of the bond element

To determine the value of the bond element we fit a Nelson-Siegel curve to the observed zero-curve for Denmark at the issue date.

5.1.2 Pricing of the option element

As seen in the descriptive analysis of the market our data set contains a number of different option types on a number of different underlying assets. In order to succeed with pricing each individual note we have chosen to price the notes in a Black-Scholes setting hence we assume constant volatility and interest rate. We are aware that exist models which may price the options more accurately but given our large number of options we start out by pricing them in this simple setup. Even though we choose a "simple" Black-Scholes world there are almost non of the options for which there exist a closed form solution. For those options where a closed form solution do exist (e.g. Margrabe for spread option) we of course use this. For options with no formula we use Monte Carlo simulation.

Most of the underlying assets (except for the currency and interest rates) that we encounter in our data set are not denominated in Danish kroner, hence we have a quanto element to take into account. Following Datey, Gauthier & Simonato (2003) [2] we assume that the underlying asset follows the risk-neutral price process given in equation (2)

$$dS_t^{(j)} = \left(r_j - \delta_j - \alpha_j \sigma_j \rho_{j,j}\right) S_t^{(j)} dt + \sigma S_t^{(j)} dW_t^{(j)} \tag{2}$$

where r_j is the risk-free interest rate, δ_j is the dividend yield, α_j is the volatility on the exchange rate, σ_j is the volatility on the underlying, $\rho_{j,j}$ is the correlation between the exchange rate and the underlying, and $W_t^{(j)}$ is a standard Brownian motion under $Q - measure$.

Since the price process is a geometric Brownian motion we know that the solution is given by equation (3)

$$S_t^{(j)} = S_0^{(j)} \cdot \exp\left[\left(r_j - \delta_j - \alpha_j \sigma_j \rho_{j,j} - \frac{1}{2}\sigma_j^2\right) t + \sigma_j W_t^{(j)}\right] \tag{3}$$

In order to simulate the value at maturity we need to estimate 5 parameters $(r_j, \delta_j, \alpha_j, \sigma_j, \rho_{j,j})$ for each underlying. For basket options we furthermore need to estimate the correlation between the individual assets in the basket.

6 Empirical results

7 Conclusion

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