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THE VALUATION OF STRUCTURED PRODUCTS: EMPIRICAL FINDINGS FOR THE SWISS MARKET

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Abstract. This article analyses the valuation of 192 structured products without a capital guarantee. In contrast to similar studies, this investigation takes in both the primary and the secondary market. Its central element is a comparison of the implied volatilities of the options contained in the structured products with those of comparable EUREX options. Generally speaking, the results may well come as a surprise both concerning the scale of the phenomenon detected and its significance. Taken as a whole, the results provide grounds for assuming that certain inefficiencies exist on the Swiss market for structured products and that lead managers manage to exploit their quasi-monopolistic position in a rational manner.

Keywords structured products, implied volatility, valuation

JEL Classification G13

1. Introduction

Structured products have experienced a massive boom in Europe in recent years. The Swiss market for structured products is characterised by wide product diversity, so producing a categorisation is far from easy. One common form of classification involves dividing up the products into those with capital guarantees and those without. Products with no capital guarantee can be further subdivided on the basis of quite specific characteristics into *products without coupon payments*, products *with coupon payments* and products with *exotic characteristics*. Products without coupon payments make it possible to purchase the underlying instrument at a discount. If, at maturity, the price of the underlying instrument is higher than or equal to the strike price, the sum paid to investors equals the strike price; otherwise they get the underlying instrument. Products with coupon payments have their repayments structured in the same way. For these products, however, instead of the discount, a coupon is paid out for the amount of the compounded discount. Economically speaking, these products are equivalent. Products with exotic characteristics exist in different shapes. Basically, such products are further developments of the first two categories, except that they have an exotic option rather than just a standard one. The study presented here considers only products *that offer no capital guarantee*.

As with other financial instruments, the question of valuation is of particular interest for structured products. The issue under scrutiny is whether the prices of structured products can be called fair or not. Examining this question for the specific case of structured products is particularly interesting on two counts. Firstly (as has already been mentioned), these products are combinations of various financial investments. If all the underlying

financial investments are traded on the market as individual entities, then it is possible to compare the price of a structured product with the sum of the prices of its component parts. This is one way of arriving at a view of how fair the valuation is. Secondly, banks and financial companies channel structured products through public issues. During the products' life, the lead managers usually maintain a secondary market in which they can purchase and/or sell the products. It is thus interesting to observe how pricing is affected by the quasi-monopolistic market position enjoyed by lead managers.

The present article deals with the valuation of 192 structured products without any capital guarantee issued on the Swiss market. The pricing of these structured products is analysed for both the time when they are issued and the secondary market. The results for the time of issue confirm the findings of previous surveys. This indicates that the valuation of structured products generally remains stable over time. For the secondary market, on the other hand, new and interesting findings emerge.

Although the first structured products appeared on the US market back in 1987, relatively little attention was paid to them in literature.[1] In the case of the USA, there are only a handful of investigations dealing with their valuation, and these go back to the time when such products were first launched. CHEN and KENSINGER (1990) investigate products with a capital guarantee issued by commercial banks at the time of their issue, whilst CHEN and SEARS (1990) analyse the pricing of one similar product in both the primary and secondary market. Both studies find that the instruments were considerably overvalued when issued, whilst the latter established an undervaluation in the secondary market. CHEN and CHEN (1995) look into the secondary market valuation of one structured product without capital guarantee. They find a persistent overvaluation amounting to some 5%. For the German market WILKENS et al. (2003) examine the pricing of roughly 900 structured products during a timeframe of 22 days. They find significant differences in the pricing of structured products, most of them favouring the issuing institution. Another study for the German market, STOIMENOV and WILKENS (2005) is based on the pricing of 2566 structured products on a single day. They find the products significantly overvalued in the primary market. In the secondary market, overpricing systematically decreases as products approach maturity. Two studies already exist for the Swiss market. WASSERFALLEN and SCHENK (1996) look into the price behaviour of thirteen structured products with a capital guarantee listed on the SMI. The results clearly show that the structured products tend to be overvalued at issue, and have a tendency to be undervalued in the secondary market. BURTH et al. (2001)[2] examine pricing at issue for 275 products with no capital guarantee. They show that at this point in time the products are, on average, valued to the investors' *dis*advantage. Their investigations also show that these misvaluations vary quite considerably, depending on the issuing institution, the product category and the involvement of co-lead managers.

The principal difference between the study presented in this article and the early work lies in the data used. The available data concerns a large number (192) of structured products without a capital guarantee and includes prices in both the primary and secondary markets. For the secondary market, data is available for almost one year. With such a database, it is possible to perform differentiated analyses for both the primary and secondary market.

The remainder of the paper is structured as follows. The section immediately following this introduction describes the study's methodology. Then the data used are presented. The empirical findings are discussed in the subsequent section, and the article finishes by presenting its conclusions.

2. Methodology

The methodology is based on the comparison of implied volatilities. In order to get the implied volatilities from a structured product, one must begin by extracting the price of the option position in-

volved in the product. Then the implied volatility can be calculated with a suitable option pricing model. For a structured product *without* coupon payments the price relationship is as follows:

$$SP_t^{WC}(X,T) = Xe^{-r(T-t)} - p_t(X,T) \qquad (1)$$

where:

$SP_t^{WC}(X,T)$:	Price of a structured product without coupon at time t, with strike price X and expiration date T
X:	Strike price
r:	Riskless interest rate (continuously compounded)
t:	Current time
T:	Expiration date
$p_t(X,T)$:	Price of a European put option with strike price X and expiration date T at time t

Equation (1) means that a structured product without coupon payments can be duplicated by a riskless investment and a short put with the same strike price and expiration date as the structured product. Equation (1) can easily be solved for the put price, and then the implied volatility can be extracted with the model of BLACK and SCHOLES (1973) adjusted for discrete dividend payments.[3]

A structured product *with* coupon payments can be duplicated in a similar way. Therefore, the price of the implicit European put option can be expressed as follows:

$$p_t(X,T) = Xe^{-r(T-t)} - SP_t^c(X,T) + \sum_j^J CP_j e^{-r(t_j-t)} \qquad (2)$$

where:

$SP_t^c(X,T)$:	Price of a structured product with coupon at time t, with strike price X and expiration date T
CP_j:	Coupon payment j (j = 1,2,…….J)
t_j:	Date of the coupon payment j

Equation (2) reveals the main difference between structured products without coupons and the products with coupons: The latter pays the premium, which results from the implicit sale of a European put option, in form of one or more coupon payments; in the other product type, the premium is contained in form of a discount at the beginning. Once the price of the European put option is calculated as in equation (2), one can extract the implied volatility of the structured product with the model of BLACK and SCHOLES (1973) adjusted for discrete dividend payments.

The procedure to extract the implied volatilities of the structured products with *exotic characteristics* is much the same as for the other product types. The only difference lies in the usage of the option pricing model. Because the structured products with exotic characteristics contain exotic options, the BLACK and SCHOLES (1973)–Model can no longer be applied. The exotic products in the database comprise structured products with barrier options and dual strike options. Therefore, the models of RUBINSTEIN and REINER (1991) for barrier options and RUBINSTEIN (1994) for dual strike options are suitable option pricing models.[4] The database in STOIMENOV and WILKENS (2005) also contains products with barrier options, and they also use the model of RUBINSTEIN and REINER (1991).

Beside the implied volatilities of the structured products, the implied volatilities from the EUREX options have to be extracted. Because EUREX options are American style, the COX et al. (1979)–Model is implemented to generate the implied volatilities.

With these volatilities, the difference in the implied volatilities $VD_{i,t}$ for each product pair i (structured product plus its assigned EUREX option) and for each point in time can be calculated according to the following expression:

$$VD_{i,t} = \sigma_{SP_i,t} - \sigma_{EU_i,t} \qquad (3)$$

where:

$VD_{i,t}$: Volatility difference of product pair i at time t
$\sigma_{SP_{i,t}}$: Implied volatility of structured product i at time t
$\sigma_{EU_{i,t}}$: Implied volatility of EUREX option i at time t

On the basis of the volatility difference arrived at using equation (3), it is possible to assess whether a product i is over– or undervalued relative to a comparable option traded in the market as a single product at time t. Given that none of the products included in the investigation have a capital guarantee, negative (positive) differences in volatility are dis-(advantageous) for investors and, accordingly, advantageous (disadvantageous) for the issuing institution. For the sake of practicability, direct transaction costs, such as brokerage charges, commissions and stamp duty, are *ignored* in the study for both the structured products and the EUREX options. This decision does cause problems at the time of issue because the direct transaction costs for the structured products are already incorporated in the product price at that time. The effect of this circumstance is that the EUREX options are given more favourable treatment when issued. Hence, any overvaluation that is shown for structured products tends to exaggerate the situation, whilst any undervaluation tends to be an understatement. No such problem arises in the secondary market since the direct transaction costs for both structured products and EUREX options can be neglected there.

The volatility differences that emerge from equation (3) are subjected to a thorough analysis. The means (μVD) and the standard deviations (σVD) of the volatility differences are primarily representative of different groups that still need to be defined in more detail. By using a one-sample t-test, it is also possible to investigate the significance of the mean difference in volatility of the particular group. For smaller sample sizes ($N < 30$), the one-sample t-test presupposes the differences in volatility to be normally distributed. Since this is not a condition that can be *a priori* regarded as satisfied, this study additionally performs the WILCOXON-signed-rank-test.[5]

3. Data

The review of previous studies on the valuation of structured products showed that there were relatively few collections of data that could serve the intended purpose. What is particularly striking is the lack of investigations into the secondary market. The main explanation for this gap is the shortage of available data for structured products. To fill the gap, the study presented here has established its own database.

Data collection started on *April 14, 1999* with 90 structured products. Up until the end of the process on *March 30, 2000*, data for *192 products* were collected. Of these, 135 are products with no capital guarantee, 41 are products with no capital guarantee but with a coupon and 16 are products with no capital guarantee and with exotic characteristics. The lead managers made the term sheets available for the 192 products included in the study. EUREX provided the daily statistics for options on Swiss equities for the entire period from June 1998 to March 2000. These statistics contain general information, such as the type of option, the underlying instrument, the strike price and the maturity, as well as the official daily closing price, the so-called *settlement price*, of each individual option.

Each structured product then had a EUREX put option assigned to it whose characteristics (strike price, time to maturity) were as similar as possible to those of the structured product. First, we tried to minimise the difference in the time to maturity between the structured product and the EUREX option. From the remaining EUREX options, we chose the one with the smallest deviation in strike price. For the resulting product pairs the implied volatilities were worked out, and the differences in volatility were calculated daily by means of

equation (3) for each day in the period under investigation.

To price the bond component that is implicitly involved in the structured products, one should apply default-adjusted interest rates. Due to the lack of bonds in the Swiss market with the same maturity and the same default risk as the issuer of the structured products, we use Swiss franc LIBOR– and swap rates. This is not a severe restriction because most of the structured products investigated in this study have a very short time to maturity. The same linearly interpolated interest rates are used to price the options in the structured products and the EUREX options. For the underlying stocks we use the daily closing prices from the Swiss Exchange (SWX). For the dividend information we work with the effective dividend payment and the effective dividend date. Where this data is not available, we make the assumption that the dividend amount will equal the amount of last year's dividend and that the dividend will be paid exactly one year after the last dividend payment. This assumption is quite reasonable as the dividend policy of Swiss companies is very stable.

Table 1 provides an overview of the structured products used for the study and the EUREX options that were paired with each of them. The table provides the following characteristic figures, broken down by product category and by lead manager: the structured products' mean time to maturity in days (Mean $(T\text{-}t)_{SP}$), the mean absolute percentage difference between the strike price of the structured product and that of the EUREX option (Mean |X-Diff|),[6] and the mean absolute difference between the time to maturity of the structured product and that of the EUREX options in days (Mean |T-Diff|). The differences in strike price and maturity are indicated both for the time of issue and for the valuation on the secondary market. The 192 products included in the study have a mean maturity of 401.4 days. The mean absolute percentage difference between the strike prices of the structured products and those of the EUREX options used for comparing valuations is 3.09% for the primary market and 1.89% for the secondary market. The mean difference in time to maturity for the entire sample is 60.80 days in the primary market and 27.83 days in the secondary market.

One point that really stands out when comparing the given characteristic indicators is the striking difference in the mean time to maturity between those products with and those products without a coupon. Contrary to this, there are no equally pronounced differences in the mean absolute percentage strike-price differences between the individual product categories or between the various lead managers. Finally, when the primary and secondary markets are compared, higher values are found in the primary market for both the mean strike-price difference and the mean difference in time to maturity. This can be explained by the process used for selecting the EUREX options, described earlier. For about half the structured products, different EUREX options are used for the secondary market than for the primary one. This mechanism helps to minimize possible distortions in the comparison of valuations that might be caused by the use of EUREX options with strongly differing strike prices and/or times to maturity.

4. Empirical Results

4.1. Entire Sample

This section analyses the entire sample comprised of 18'598 volatility differences for both the primary and the secondary market. Figure 1 presents the frequencies of the volatility differences in the primary and the secondary market. It shows that the primary-market differences are very scattered and extend into both the negative and positive zones (minimum: −18.62%; maximum: 7.84%). In the secondary market, the spread is even more extreme (minimum: −21%; maximum 19%). At the time of their issue, thirteen products (6.8%) from the total sample were offered with a positive

Table 1: Overview of the Data Used as a Basis for this Study

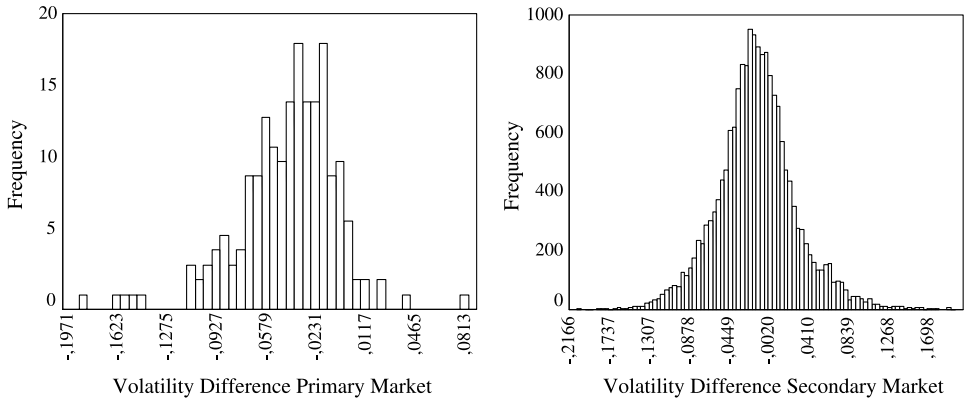
	N	Mean $(T\text{-}t)_{SP}$ (Days)	Mean |X-Diff|		Mean |T-Diff| (Days)	
			Primary M.	Secondary M.	Primary M.	Secondary M.
Entire Sample	192	401.40	3.09%	1.89%	60.80	27.83
Products without Coupon	135	317.78	2.72%	1.39%	30.38	15.16
ABN Amro	21	305.00	2.53%	0.58%	17.19	10.62
Bank Julius Bär	1	142.00	0.61%	0.61%	0.00	0.00
Crédit Lyonnais	7	271.14	2.88%	1.28%	24.00	21.00
CSFB	17	370.18	3.11%	3.18%	53.29	23.88
HSBC	10	306.30	2.34%	1.31%	34.00	15.80
Merrill Lynch	27	281.85	2.49%	1.22%	18.15	7.30
Morgan Stanley	11	301.91	3.03%	0.55%	29.82	9.00
Salomon Smith Barney	6	343.00	0.88%	0.00%	51.50	13.17
UBS	19	371.37	3.81%	2.29%	39.32	23.16
ZKB	16	315.88	2.42%	1.13%	28.25	19.19
Products with Coupon	41	645.76	4.06%	2.88%	160.80	72.17
ABN Amro	1	733.00	8.38%	8.38%	52.00	52.00
Banque Cantonale Vaudoise	7	477.29	1.94%	1.37%	55.29	37.57
Crédit Lyonnais	9	622.44	4.20%	3.08%	100.22	29.44
CSFB	6	745.00	4.94%	3.14%	255.33	55.83
Société Générale	1	367.00	0.00%	0.00%	21.00	21.00
UBS	5	864.60	5.43%	4.07%	329.20	66.80
Bank J. Vontobel	12	636.67	4.18%	2.78%	171.08	140.75
Exotic Products	16	480.81	3.77%	3.53%	61.19	20.25
Crédit Lyonnais	10	423.20	2.99%	2.23%	48.30	26.60
CSFB	3	746.33	5.11%	6.39%	165.33	19.33
Merrill Lynch	3	407.33	4.99%	4.99%	0.00	0.00

Notes:
Mean $(T\text{-}t)_{SP}$: mean time to maturity of the structured products (days).
Mean |X-Diff|: mean absolute percentage difference between the strike prices of the structured products and those of the EUREX options used for comparison.
Mean |T-Diff|: mean absolute difference between the maturity date of the structured products and that of the EUREX options used for comparison (days).

difference in volatility and thus at conditions advantageous to investors as far as their price was concerned. This figure contrasts with the one found for the secondary market: about 60% of the products there display a positive difference in volatility. It is possible to interpret this as an indication that structured products tend to be valued more favourably from the investor's point of view in the secondary market than at the time of issue. This initial indication is, however, subject to a more detailed examination later on.

Table 2 displays the statistics for the volatility differences of the entire sample for the primary and the secondary market. At the time of issue, the mean difference in volatility is −4.25%. This indicates that the structured products examined were clearly valued to the investors' *dis*advantage. The t-value of −16.67 that emerges also shows that this value is different from zero for all plausible significance levels. The discovered misvaluation is thus significant. This finding agrees with the results published by BURTH et al. (2001) and WASSERFALLEN and SCHENK (1996) and confirms that structured products in Switzerland are in general wrongly valued to the investors' *dis*advantage at the time they are issued. On average, issuing institutions value structured products to their own advantage. From this it follows that it ought to be possible for investors to pursue the same strategy, which in their case would involve trading EUREX options at advantageous conditions.

Figure 1: Frequency Distribution of Volatility Differences (VD) in the Primary (Left) and Secondary (Right) Market



The results for the primary market need to be somewhat differentiated in two respects, however. First, the direct transaction costs (brokerage charges, commissions, etc.) have not been fully included in the study for reasons of practicability. The transaction costs of the EUREX options in the primary market are ignored, whereas a part of the direct transaction costs for structured products is already included in the price in the form of a surcharge that issuers place on top of the actual price of issue.[7] If this fact were to be taken into consideration, it would tend to reduce the misvaluation that has been discovered. The second reason is also evident in Table 1, namely that the times to maturity of the structured products examined differ from those of the selected EUREX options by a mean of approximately 60 days. This suggests that investors would not be able to deploy EUREX options to secure precisely the payoff pattern of the structured products. From the lead manager's perspective, the differences in mean times to maturity have the effect that the liabilities resulting from the issue of structured products can no longer be hedged statically. In such circumstances, it is not certain that the lead manager will be able to realise the profit resulting from the volatility spread. In other words, there could be an economic reason that justifies part of the difference in volatility at the time of issue. However, as will be shown in a section below, the volatility differences in the primary market can at best only partly be explained by the matching differences in the time to maturity.

In the secondary market, the mean difference in volatility is still −1.65%. Although this value is still negative and thus shows that secondary-

Table 2: Descriptive Statistics for the Entire Sample, Divided into two Subsamples, One for the Primary Market and the Other for the Secondary Market

	N	μVD	σVD	*t-Value*
Primary Market	192	−4.25%	3.53%	−16.67***
Secondary Market	18'406	−1.65%	4.32%	−51.62***

Notes:
N: number of data points, μVD: mean volatility difference, σVD: standard deviation of volatility differences.
***: t-values significant at the 1% level.

market pricing is, on average, also to the investors' *dis*advantage, it is noticeably less negative than the value for the primary market. It should be further noted that the dispersion of the differences in volatility is only marginally greater than in the primary market. The t-value shows that the mean difference in volatility in the secondary market is highly significant. Although this result indicates that, generally, issuing institutions still value products in the secondary market to their advantage, it also shows that the extent of the misvaluation has been reduced. This finding tallies in part with the results published by WASSERFALLEN and SCHENK (1996), whose conclusion was that issuers were even pricing to the investors' *advantage* in the secondary market.[8] The relativisation that was brought forward for the primary market is not applicable to the results for the secondary market. Firstly, because structured products and EUREX options are treated in the same way concerning direct transaction costs for the study of the secondary market. Secondly, because the (absolute) difference in time to maturity in the secondary market is considerably lower than in the primary market: the mean of this difference is 27.82 days. This means that structured products in the Swiss market are valued significantly to investors' *dis*advantage in both the primary and secondary markets, on average. The extent of misvaluation is appreciably greater in the primary market than in the secondary one. To test for significance, a t-test is applied to the differences in the means. For the purpose of this test, it is relevant whether populations from which the samples were drawn have the same variances. Therefore, a LEVENE (1960) test needs to be performed first. The resulting LEVENE statistic of 8.049 leads to the rejection of the null hypothesis at all conventional significance levels. So it now has to be assumed that the differences in volatility in the primary and secondary market do not have the same variance. This allows to test for differences in the means by using the test statistic with standard-normal distribution for unknown and possibly unequal variances (the *z*-test). For the two groups under investigation, the resultant z-value is -10.138. The two group means are thus significantly different from one another at all conventional levels.

It could be assumed that one reason for the difference in pricing between the primary and secondary markets is the issuer's premium. This is an amount added onto the actual product price that represents compensation paid at the time of issue to the lead manager (and any co-lead manager(s) that might be involved). It is, however, not possible to maintain such a surcharge in the secondary market, given that, as structured products approach their maturity date, the likelihood is greater that they will be offered back to the lead manager. It is reasonable to assume that the issuer's mark-up is at least one reason for the significant pricing difference between the primary and secondary market. One final point has to be made that is applicable not only to the comparison between the primary and secondary market presented in this section but also to those in following sections: namely that different EUREX options were selected for computing the volatility difference in the two markets. Part of the differences in valuation shown here and later on could be due to this selection.

4.2. Differentiation by Lead Manager

This section examines what influence the lead manager has on pricing in the primary and secondary market. For this purpose, the differences in volatility of the entire sample are grouped according to the lead manager. For these subgroups, the same steps are followed as for the entire sample: the means (μVD) and the standard deviations (σVD) of the volatility differences, as well as the one-sample t-test are computed. Given the small sample sizes at the time of issue, a WILCOXON-test is also performed. In addition to this, a test is carried out for each group to determine whether the results for the primary market differ significantly from those for the secondary market.

However, contrary to the preceding section of this article, the sample sizes of the subsamples are no longer large enough for the central limit theorem to be applied. Since there are no grounds for assuming that the individual samples come from populations with a normal distribution, the two-sample t-test is not adequate. A non-parameterised alternative to the two-sample t-test is available in the form of the MANN and WHITNEY (1947) U-test. For large random samples ($n_1 + n_2 > 60$), U approximately has a standard normal distribution, and it is thus possible to compute a $\tilde{z}$ statistic.

Table 3 gives the statistics for the volatility differences for the products from the individual lead managers. It gives not only the $\tilde{z}$ -value, but also the values for the primary and secondary markets. It does not entirely come as a surprise that Table 3 should confirm the results from the previous section. For virtually all lead managers, the pricing in both the primary and the secondary market turns out to be to the investors' *dis*advantage. For all lead managers and for both periods under study, the misvaluations are different from zero at least at the 10% level. The table also confirms the result already presented that the misvaluation in the secondary market is less than in the primary one. With the sole exception of the results for Bank J. Vontobel, the mean differences in volatility at the time of issue are smaller or more negative for all lead managers than in the secondary market.

Striking differences appear between the individual lead managers concerning both the mean differ-

Table 3: Groups According to the Issuing Institution, Divided into Subsamples for the Primary and Secondary Markets

		N	μVD	σVD	*t-Value*	*W-Value*	$\tilde{z}$ *-Value*
ABN Amro	Primary Market	22	−3.00%	2.62%	−5.38***	16***	−2.62***
	Secondary Market	1'208	−1.16%	3.44%	−11.76***		
Bank Julius Bär	Primary Market	1	−6.72%		°	°	°
	Secondary Market	36	5.18%	3.18%	9.78***		
Bank J. Vontobel	Primary Market	12	−4.25%	2.32%	−6.35***	0***	−1.07
	Secondary Market	1'858	−5.12%	3.16%	−69.94***		
BCV	Primary Market	7	−4.02%	1.37%	−7.74***	0***	−1.30
	Secondary Market	710	−1.15%	5.72%	−5.35***		
Crédit Lyonnais	Primary Market	26	−7.13%	3.49%	−10.42***	0***	−7.69***
	Secondary Market	3'031	0.60%	4.12%	7.98***		
CSFB	Primary Market	26	−6.57%	3.58%	−9.37***	1***	−3.59***
	Secondary Market	2'498	−3.48%	4.87%	−35.75***		
HSBC	Primary Market	10	−4.08%	3.66%	−3.53***	3***	−2.12**
	Secondary Market	532	−1.16%	3.82%	−6.99***		
Merrill Lynch	Primary Market	30	−2.52%	2.99%	−4.61***	41***	−4.62***
	Secondary Market	2'697	−0.39%	3.05%	−6.57%		
Morgan Stanley	Primary Market	11	−3.02%	3.76%	−2.67**	9**	−1.54
	Secondary Market	749	−1.22%	3.34%	−9.97***		
Salomon S.B.	Primary Market	6	−1.36%	1.46%	−2.28*	3*	−0.91
	Secondary Market	588	0.39%	3.05%	−6.57***		
Société Générale	Primary Market	1	−3.17%		°	°	°
	Secondary Market	103	1.78%	1.56%	11.57***		
UBS	Primary Market	24	−4.58%	3.95%	−5.68***	1***	−1.53
	Secondary Market	2'659	−2.78%	4.29%	−33.47***		
ZKB	Primary Market	16	−2.30%	1.52%	−6.05***	1***	−1.49
	Secondary Market	1'737	−1.32%	2.84%	−19.33***		

Notes:
N: number of data points, μVD: mean volatility difference, σVD: standard deviation of volatility differences.
t-values, W-values and $\tilde{z}$ -values significant at the 1, 5 and 10% levels are denoted by ***, ** and *, respectively.
° denotes subsamples too small for testing significance.

ences in volatility and the dispersion of the differences. If we examine the results for the time of issue, then it is possible to identify a top group out of those lead managers who are represented with more than five products in the random sample: Salomon Smith Barney, Zürcher Kantonalbank (ZKB) and Merrill Lynch. These three institutions display values in the range of −1.36% to −2.52%, which are the smallest misvaluations to the investors' *dis*advantage. The spread of the volatility differences is also smallest for Salomon Smith Barney and Zürcher Kantonalbank, whilst Merrill Lynch places midfield. This shows that for the period under study the three named institutions issued the products with the most attractive conditions, and that the risk of a misvaluation was relatively low at the same time. From Table 3 it is also possible to discern a middle group as well as two lead managers whose pricing at the time of issue differs noticeably from their competitors. Crédit Lyonnais and Credit Suisse First Boston show significant mean differences in volatility of −7.13% and −6.57%, respectively. These values are clearly more negative than those of all the other issuing institutions.

A look at the results for the secondary market shows that the differences between the individual lead managers are not quite as pronounced as those found in the primary market. Whereas all the lead managers show negative differences in volatility at the time of issue, the mean differences in volatility in the secondary market are actually positive for four issuing institutions: Crédit Lyonnais, Salomon Smith Barney, Bank Julius Bär and Société Générale. It will be demonstrated in a later part of this article that these positive differences in volatility can all be shown to occur within a particular period. Apart from this, Bank J. Vontobel exhibits the most negative volatility difference of −5.12% in the secondary market. Finally, the low $\tilde{z}$ -values of six lead managers (Bank J. Vontobel, BCV, Morgan Stanley, SSB, UBS and ZKB) do not indicate significant differences between the primary and the secondary market. For five other issuing institutions (ABN Amro, Crédit Lyonnais, CSFB, HSBC, Merrill Lynch) on the other hand, the difference is significant at the 5% and 10% significance levels. One possible reason for this reduction in the extent of misvaluation is the fact that structured products can only be *bought* at the time of issue, whereas it is possible for them to be both *bought* and *sold* in the secondary market. Since lead managers are aware of this possibility, prices in the secondary market are closer to the product's fair value.

4.3. Differentiation by Product Type

We now turn to the question whether the type of product has an influence on its valuation. It is worth reiterating that this study deals solely with products that do not include a capital guarantee. Given that, in economic terms, products with and without coupon payments are equivalents, it can be expected that there will be no significant difference in their valuations. For the third category, this hypothesis only applies with reservations. Since the structured products with no capital guarantee but with exotic characteristics form a very heterogeneous product group, it would be wrong to start with an *a priori* assumption that their valuation will be the same as the valuation of products belonging to the two other categories.

Table 4 summarizes the statistics for the groups presented above. It lists the same parameters as Table 3. It can be seen that the mean differences in volatility are negative for all three product groups in both the primary and secondary market. All three product categories demonstrate significant misvaluations in both markets. At the same time, it can be noted that the misvaluations in the secondary market are lower than in the primary market for all the product categories. The $\tilde{z}$ -values from the MANN and WHITNEY test also show that this difference is significant for all product categories. This result confirms the findings of the two preceding sections, that valuation

Table 4: Groups According to Product Type and Issuing Institution Divided into Two Subsamples, One for the Primary Market and the Other for the Secondary Market

		N	μVD	σVD	*t-Value*	*W-Value*	$\tilde{z}$ *-Value*
Products without C.	Primary Market	135	−3.35%	2.87%	−13.55***		−8.02***
	Secondary Market	10'785	−1.00%	3.64%	−28.62***		
ABN Amro	Primary Market	21	−2.85%	2.58%	−5.06***	16***	−2.40
	Secondary Market	1'192	−1.13%	3.44%	−11.31***		
Bank Julius Bär	Primary Market	1	−6.72%		°	°	°
	Secondary Market	36	5.18%	3.18%	9.78***		
Crédit Lyonnais	Primary Market	7	−6.67%	2.73%	−6.46***	0***	−3.66***
	Secondary Market	535	−0.43%	3.77%	−2.62***		
CSFB	Primary Market	17	−4.82%	1.99%	−4.82***	1***	−2.89***
	Secondary Market	1'365	−2.69	4.02%	−2.69***		
HSBC	Primary Market	10	−4.08	3.66%	−3.53***	3***	−2.12**
	Secondary Market	532	−1.16	3.82%	−6.99***		
Merrill Lynch	Primary Market	30	−2.52	2.99%	−4.61***	38***	−4.62***
	Secondary Market	2'697	0.39	3.05%	−6.57***		
Morgan Stanley	Primary Market	11	−3.02	3.76%	−2.67**	9**	−1.54
	Secondary Market	749	−1.22	3.34%	−9.97***		
SSB	Primary Market	6	−1.36	1.46%	−2.28*	3*	−0.91
	Secondary Market	588	−0.39	4.66%	2.02***		
UBS	Primary Market	19	−3.82	2.28%	−7.31***	1***	−3.30***
	Secondary Market	1'621	−1.04	3.90%	−10.72***		
ZKB	Primary Market	16	−2.30	1.52%	−6.05***	1***	−1.49
	Secondary Market	1'737	−1.32	2.84%	−19.33***		
Products with Coupon	Primary Market	41	−6.31	4.07%	−9.33***		−4.41***
	Secondary Market	5'907	−2.52	5.13%	−37.71***		
ABN Amro	Primary Market	1	−6.19		°	°	°
	Secondary Market	16	−3.77	1.38%	−10.95***		
Bank J. Vontobel	Primary Market	12	−4.25	2.32%	−6.35***	0***	−1.07
	Secondary Market	1'858	−5.12	3.16%	−69.94***		
BCV	Primary Market	7	−4.02	1.37%	−7.74***	0***	−1.30
	Secondary Market	710	−1.15	5.72%	−5.35***		
Crédit Lyonnais	Primary Market	9	−9.23	4.48%	−6.18***	0***	−5.00***
	Secondary Market	1'443	−2.45	3.94%	23.63***		
CSFB	Primary Market	6	−8.31	1.65%	−12.38***	0***	−2.72***
	Secondary Market	739	−3.36	5.00%	−18.26***		
Société Générale	Primary Market	1	−3.17		°	°	°
	Secondary Market	103	1.78	1.56%	11.57***		
UBS	Primary Market	5	−7.47	7.29%	−2.29*	0***	−0.15
	Secondary Market	1'038	−5.51	3.35%	−53.00***		
Exotic Products	Primary Market	16	−6.58	4.03%	−6.53***		−3.92***
	Secondary Market	1'714	−2.67	4.49%	−24.59***		
Crédit Lyonnais	Primary Market	10	−5.56	1.93%	−9.12***	0***	−3.99***
	Secondary Market	1'053	−1.42	3.35%	−13.71***		
CSFB	Primary Market	3	−12.98	4.96%	°	°	°
	Secondary Market	394	−6.47	6.02%	−21.32***		
Merrill Lynch	Primary Market	3	−3.59	8.81%	°	°	°
	Secondary Market	267	−2.00	2.00%	−16.41***		

Notes:
N: number of data points, μVD: mean volatility difference, σVD: standard deviation of volatility differences.
t-values, W-values and $\tilde{z}$ -values significant at the 1, 5 and 10% level are denoted by ***, ** and *, respectively.
° denotes subsamples too small for testing significance.

in the secondary market is generally fairer than in the primary market.

If the mean differences in volatility of the three groups are compared, it emerges that the products without coupons are, on average, valued more fairly in both the primary and secondary market than are the products with coupons and the products with exotic characteristics. For instance, the mean misvaluation of the structured products without a coupon at the time of issue is only about half (−3.35%), the misvaluation shown for the products with coupons (−6.31%) and for the exotic products (−6.58%). Astonishingly, the misvaluation and the variation in the differences in volatility of the products with coupons and the products with exotic characteristics are virtually identical, both in the primary and in the secondary market. On average, the products without coupon payments are thus offered at considerably more favourable conditions both at the time of issue and in the secondary market than are their pendants with coupon payments and exotic characteristics.

At this point it should be mentioned that these results can also be caused by the deviations in the time to maturity between the structured products and the EUREX options. As we have seen in Table 1, the differences in the time to maturity between the structured products and the comparable EUREX options are much more pronounced for the structured products with coupons than for the structured products without coupon payments. Therefore, it is possible that the misvaluation between the different product types is provoked—at least in part—by this time to maturity difference. However, in the secondary market, where the differences in the time to maturity are much smaller, the misvaluation between the different product types remains quite high (−1% for products without coupons vs. −2.52% for products with coupon and −2.67% for products with exotic characteristics). This supports the interpretation that the results in this study are not very biased with regard to the time to maturity differences.

The next step is to examine whether the established valuation pattern is of a systematic nature. Since the means of more than two groups will be compared, it is no longer possible to use the two-sample t-test as described in the preceding section. The test that is used instead is a pairwise multiple comparison according to GAMES and HOWELL (1976).

The values for the product categories examined are presented in Table 5. They show that the valuation of the structured products without coupons varies significantly from that of the products with coupons in both the primary and secondary market at all the conventional levels. At least at the 5% level, there is a significant difference between the valuation of the products without coupons and that of the structured products with exotic characteristics. On the other hand, the differences in valuation between the products with coupons and the products with exotic characteristics are not systematic in nature. It can thus be concluded that products with a

Table 5: Pairwise Multiple Comparison of Means According to GAMES and HOWELL (1976) for Product Types in the Primary and Secondary Market

		Mean Difference
Without C./With Coupon	Primary Market	2.97% ***
	Secondary Market	1.52% ***
Without Coupon/Exotic Products	Primary Market	3.24% **
	Secondary Market	1.66% ***
With Coupon/Exotic Products	Primary Market	0.27%
	Secondary Market	0.15%

Note:
Pairwise mean differences significant at the 1 and 5% level are denoted by *** and **, respectively.

coupon and products with exotic characteristics were systematically given a poorer valuation in the period investigated than were the products without coupon payments, and that this was the case for both the primary and secondary market.
The research presented here provides circumstantial evidence that the issuing institutions systematically value the various categories of structured products differently, despite the fact that the products are very similar as far as their economic characteristics are concerned. It is evident that certain product categories are systematically disadvantaged compared with others. It is, however, possible to put forward explanations for the valuation differences that have been detected. The first reason lies in the different competitive situations of the various product categories. In describing the Swiss market, WOHLWEND (2001) shows that for products without coupon payments twice as many lead managers have significant market shares than for the other product categories. The results presented in Tables 4 and 5 provide evidence that this greater intensity of competition has a positive influence on the pricing of products without coupon payments. The higher concentration of market shares in the other product categories, on the other hand, does little to promote competitive pricing. A further reason is to be sought in the general market environment of the late 1990s. Given the fact that capital-market interest rates were very low, it can be assumed that a number of investors allowed themselves to be enticed by the visually attractive coupon payments of structured products with coupons, but failed to make the correct appraisal of the risks inherent in such products. A third factor seems to be that institutional investors contributed to a buoyant demand (and thus to a strong growth in the market) for products with coupon payments. A massive institutional demand is the only possible explanation for the fact that certain issues of structured products with coupon payments had to be augmented by up to seven times their original volume.

4.4. The Valuation of Structured Products Over Time

This section focuses on the analysis of the 18'406 differences in volatility for the secondary market. Specifically, it is analysed whether any time-dependent patterns can be detected in the values. The question of greatest interest here is whether the structured products are systematically valued differently in particular phases of their life cycle than in others. Given that structured products are derivative financial instruments that have a date of issue and a maturity date, it would be an obvious assumption that these two important points in time have an influence on valuation. This idea provide the motivation for the following methodology. The entire sample is divided up into three groups. The first group is formed of those differences in volatility that occur within the first 120 days of the structured product's time of issue. The second group is comprised of those differences in volatility which occur less than or precisely 120 days before the maturity date of the particular product. The third group, finally, is made up of all the remaining differences in volatility. In those cases in which the two 120-day periods overlap (i.e., where the product's total life is less than 241 days), the differences in volatility that appear in both groups simultaneously are eliminated from the evaluation. The total number of data points excluded for this reason is, however, relatively small, being only 477, and all of these happen to come from the category of products without coupons.
Table 6 presents the results of this investigation. It contains the number of observations, the mean difference in volatility, the standard deviation of the difference in volatility and the t-value both for the totality of the products taken together and for each of the individual product categories.
There is a remarkable correspondence amongst the results for the various categories. For all categories, the extent of the misvaluation to the investors' *dis*advantage declines perceptibly over the course

Table 6: The Pricing of Structured Products in the Secondary Market

	N	μVD	σVD	*t-Value*
Entire Sample				
120 Days after Issue	5'376	−3.50%	3.09%	−82.86***
Between	8'246	−2.03%	4.10%	−44.98***
120 Days before Maturity	4'307	1.36%	4.44%	20.03***
Products without C.				
120 Days after Issue	3'222	−2.72%	2.60%	−59.53***
Between	3'401	−1.62%	2.94%	−32.07***
120 Days before Maturity	3'685	1.09%	3.85%	17.17***
Products with Coupon				
120 Days after Issue	1'300	−5.43%	2.84%	−68.84***
Between	4'004	−2.42%	4.67%	−32.74***
120 Days before Maturity	603	3.07%	6.82%	11.04***
Exotic Products				
120 Days after Issue	854	−3.84%	3.83%	−26.56***
Between	841	−1.88%	4.98%	−10.95***
120 Days before Maturity	19	−1.20%	2.59%	−2.02*, °°

Notes:
N: number of data points, μVD: mean volatility difference, σVD: standard deviation of the volatility differences.
***: t-values significant at the 1% level, **: t-values significant at the 5% level.
°° denotes the non-parametric WILCOXON signed-rank test that leads to the same result as the t-test.

of time. The mean differences in volatility during the first 120 days following issue are notably lower (i.e., more negative) for all the product categories than the mean differences during the middle period or during the last 120 days prior to maturity. Surprisingly, the mean differences during the last 120 days prior to maturity are even positive (with the exception of the exotic products[9]). The pattern is most pronounced for the structured products with coupon payments. Directly after issue, the difference in volatility for this product category is strongly negative, at −5.43%, whereas it is in the positive zone shortly before maturity. It is worth noting that the mean difference in volatility for all the categories remains within a narrow range during the middle period (−2.42% to −1.62%).

In order to establish whether the valuations for the individual periods of time are significantly different, a pairwise multiple comparison of means according to GAMES and HOWELL (1976) is carried out for all the products and also for the individual product categories (with the exception of the exotic products). Given the small size of the sample for the exotic products in the last of the three groups (120 days prior to maturity) the only test that is performed is a two-sample t-test to establish whether the mean differences in volatility of the first two groups are significantly different. The results of these tests are summarised in Table 7.

The results in Table 7 show that all the mean differences in volatility differ significantly from each other for each of the periods examined. The valuation of structured products in the secondary market is systematically different and dependent on the life cycle of the products (irrespective of the type of product).

The differences in valuation can perhaps be explained as follows: Structured products are derivative financial instruments with fixed maturities. The products' life cycle generally starts when investors buy them. It is pretty unlikely that investors will rush into reselling structured products immediately after their issue, especially since products that imply a short option position profit particularly as their residual duration dwindles. It follows that, in the phase immediately after issue, the lead managers can set the prices of structured products higher than the fair level without incur-

Table 7: Pairwise Multiple Comparison of Means According to GAMES and HOWELL (1976) for Different Periods of Time

	Mean Difference
All Products	
After Issue/In-Between	−1.47% ***
After Issue/Before Maturity	−4.85% ***
Between/Before Maturity	−3.39% ***
Products without Coupon	
After Issue/In-Between	−1.10% ***
After Issue/Before Maturity	−3.81% ***
Between/Before Maturity	−2.71% ***
Products with Coupon	
After Issue/In-Between	−3.01% ***
After Issue/Before Maturity	−8.49% ***
Between/Before Maturity	−5.48% ***
Exotic Products	
After Issue/In-Between	−7.38% ***

Note:
***: Pairwise mean differences significant at the 1% level.

ring any major exposure. In this way, they are able to maximise their profit, without running any risk that would be out of due proportion. Following this initial phase, the lead managers are then forced to move over to a different mode of pricing. During this middle period, the actual flow of orders is no longer so predictable. As a general trend, the number of purchases and sales orders are likely to be in equilibrium during this phase. That being so, lead managers are well advised to set prices close the fair value. Then, the only profit they can make is from the margin between the bid and offer prices. Such behavior would also constitute a suitable explanation for the remarkably narrow range within which the mean differences in volatility move for all product categories during the second phase. During the third phase, the period of time just before maturity, the situation changes radically once again. The likelihood of investors selling increases, whereas, as the final term nears, it becomes increasingly less likely that any new purchase orders will be received for a given product. It frequently happens that lead managers offer investors new products with similar characteristics and in that way try to convince them to carry out rollover transactions. In such a situation, the issuers can also make a profit with relatively little risk by setting prices for the structured products lower than the fair level. In other words, the implied volatilities of the structured products are higher than the volatilities of the comparable EUREX options, which results in a positive difference in volatility.[10] The results presented here thus show that it is possible for lead managers to leverage their quasi-monopolistic market position in a rational manner in order to realise profits.

Against the background of the results of this current section, the findings given for the valuation in the secondary market in earlier sections of this article now partially need to be reinterpreted. In Sections 4.1–4.3, the point is made several times that structured products are on average valued more fairly in the secondary market than in the primary one. For individual lead managers, the study even found significantly positive volatility means. These results must now be differentiated in two respects:

1. It is true that, on average, structured products have misvaluations that are less to the investors' *dis*advantage in the secondary market than in the primary market. However, it would be wrong to deduce from this that investors ought to be recommended to purchase structured products preferentially in the secondary market. As the results presented in this section show, the valuation of the products in the phase immediately following their issue is not more attractive than at the time of issue itself.
2. It would also be a mistake to conclude from the finding that the products of certain lead managers are, on average, undervalued in the secondary market, that their products are to be recommended as particularly attractive. It appears, it is precisely the products of such lead managers whose valuation patterns are the most time-dependent. That means that these are the lead managers who make the most consistent use of their quasi-monopolistic market position for their own advantage.

4.5. The Influence of the Matching Differences

The results so far have shown that in the Swiss market for structured products various inefficiencies exist. Structured Products are on average overvalued and the misvaluation depends on the lead manager, the product type and the life cycle of the product. Before we can draw a conclusion from these results we have to assure that the results are not significantly influenced by the matching differences resulting from the comparison between structured products and Eurex options. In the presentation of the data it was shown that the implicit option position of the structured product and the comparable Eurex option do not have the same characteristics in every case. The matching differences are displayed in Table 1. The table exhibits the strike price differences and the differences in the time to maturity for the whole sample as well as for various subsamples. The data show that the differences in the time to maturity are much more pronounced than the strike price differences. Furthermore, the differences in the time to maturity are smaller in the secondary market than in the primary market. This discrepancy is caused by the matching procedure where for the primary market and the secondary market different Eurex options are chosen to minimise the matching differences as much as possible. Finally, the data in Table 1 shows that the differences in the time to maturity are particularly large for the products with a coupon.

In this section we analyse if the differences in the time to maturity between the implicit option position in the structured products and the compared Eurex options influence the results found so far. The influence of the strike price differences is not examined because these differences are negligible in comparison to the differences in the time to maturity. We divide the primary market sample of the products without coupon and the products with coupon into several sub-samples (the exotic products are not taken into consideration due to the small number of products). We concentrate on the primary market because the matching differences in the time to maturity are much smaller. We build seven subsamples according to the absolute differences in the time to maturity in the primary market (see Table 8).

The sample without coupon contains 135 products. 86 products exhibit a difference in the time to maturity between 0 and 30 days. For the products with coupon only 6 products fall into this subsample. Table 8 shows the difference between the two products categories. While about 80% (106 products) without coupon have differences in the time to maturity of up to 60 days, only 39% (16 products) of the products with coupon belong to this category. The same number of products show a difference in the time to maturity of more than 120

Table 8: Number of Products in the Subsamples to Test the Influence of the Matching Differences in the Time to Maturity on the Pricing of the Structured Products

Absolute Difference in the Time to Maturity (in Days)	*Products without Coupon (Primary Market)*	*Products with Coupon (Primary Market)*
All Products	135	41
<= 30	86	6
31–60	20	10
61–90	17	6
91–120	9	3
>120	3	16
All without > 120	132	25

Note:
The subsamples are built according to the differences in the time to maturity between the structured products an the Eurex options.

days. It is now examined if these matching differences induce an estimation bias in the results found so far.

The results for the various subsamples are displayed in Table 9. The results for the *products without coupon* show that the mean volatility differences (μVD) of the subsamples are within a narrow range. An exception are the products in the 91 to 120 days subsample but the mean volatility difference is not significantly different from zero. If we exclude the products with the biggest differences (the ''all without >120'' sample) we see that the mean volatility difference is barely affected by the products with the biggest difference in the time to maturity. From these results we can conclude that the products without coupon are not influenced by the differences in the time to maturity between the structured products and the Eurex options. The results for the *products with coupon* are similar. The mean volatility differences (μVD) are comparable to each other with one exception: the mean volatility difference of the subsample with differences in the time to maturity of more than 120 days is −8.32% and this value is significantly different from zero. If we exclude these products from the whole sample (the ''all without >120'' sample), we find a value of −5.02%, which is significant at the 5%–level. This means, if we assume that the negative value of −8.32% for the group with the largest differences in the time to maturity is only induced by the matching differences (and not by economic reasons), the mean volatility difference for the products with coupons is −5.02%. A comparison of this value to the value for the whole sample (−6.31%) shows that the first one is only slightly lower than the second one. Additionally, a MANN–WHITNEY-U-Test shows that these two values are not significantly different (U-value: 433.5, significance.: 0.296). These results signify that the differences in the time to maturity do not have a big impact on the mean volatility differences of the products with a coupon. But even if the mean volatility difference for the products with coupon was really −5.02%, the results in the sections above would remain valid. The value of −5.02% for the products without coupon would still indicate an apparent overvaluation in comparison to the −3.35% for the products without coupon. Therefore, the influence of the differences in the time to maturity on the pricing of the structured products with coupon is weak at best.

In summary, the results of this section show that it is very unlikely that the differences in the time to maturity between the structured products and the comparable Eurex option influence the results found in the sections above.

Table 9: Subsamples According to the Difference in the Time to Maturity between the Structured Product an the Eurex-Option

Absolute Difference in the	*Products without C. (Primary Market)*				*Products with C. (Primary Market)*			
Time to Maturity (in Days)	*N*	*μVU*	*σVU*	*W-Value*	*N*	*μVU*	*σVU*	*W-Value*
All Products	135	−3.35%	2.87%	8794 ***	41	−6.31%	4.07%	861 ***
<= 30	86	−3.37%	2.84%	3612 ***	6	−5.17%	3.33%	21 **
31–60	20	−3.46%	2.43%	209 ***	10	−4.97%	3.50%	55 ***
61–90	17	−3.41%	2.45%	150 ***	6	−4.52%	1.94%	21 **
91–120	9	−1.52%	4.13%	33	3	−5.94%	1.00%	°
>120	3	−4.20%	4.42%	°	16	−8.32%	4.94%	136 ***
All without > 120	132	−3.33%	2.85%	8410 ***	25	−5.02%	2.82%	325 **

Note:
N: number of data points, μVD: mean volatility difference, σVD: standard deviation of volatility differences. W-values (WILCOXON-signed-rank-test) significant at the 1, 5 and 10% level are denoted by ***, ** and *, respectively. ° denotes subsamples too small for testing significance.

5. Conclusions

This article examines the valuation of 192 structured products that offer no capital guarantee. It surveys both the primary and the secondary market in Switzerland. The investigation of the secondary market covers the period from April 14, 1999 to March 30, 2000. The investigation for the primary market is based on the issue prices as published in the term sheets. The core of the investigation is a comparison between the implied volatilities of the options incorporated in the structured products with those of comparable EUREX options. This comparison results in a total of 18'598 volatility differences, and these are the data points that form the basis for the various evaluations.

The results for the *entire sample* show that structured products are, on average, valued to the investors' *dis*advantage when they are issued. In general, market misvaluations to the investors' *dis*advantage are detected for the secondary market, too; the extent of this phenomenon is, however, considerably less pronounced than the misvaluation at the time of issue. The results for the primary market need to be differentiated in one respect. For the sake of practicability, the full direct transaction costs for the structured products at the time of issue could not be included in the study. Such a relativisation of the results is not, however, applicable to those from the secondary market. The analysis of the products from different *lead managers* shows that the valuation differs markedly for some of them in both the primary and secondary market. Similarly, large and significant differences also emerged during the investigation of the various *product categories*. The valuation of products without coupon payments is, on average, clearly more fair both at the time of issue and in the secondary market than is the valuation of products with coupon payments and those with exotic characteristics. This finding is particularly interesting since these products are economically equivalent to one another (with the exception of the products with exotic characteristics). It would thus seem sensible to assume that, in the case of the products with a coupon, the issuing banks are practising horizontal price differentiation. In the investigation of the valuation of the structured products *over time* it has been shown that there is a significant time-dependent valuation pattern in the secondary market that affects all the product categories. The prices for the structured products are set significantly higher (relative to the prices of the comparable EUREX options) in the time immediately after issue. The only possible explanation for this time-dependent valuation pattern is that lead managers endeavour to maximise their profits. The picture produced by these results give rise to the assumption that there are certain inefficiencies in the Swiss market for structured products and that the lead managers are making rational use of their quasi-monopolistic position. It seems likely that restrictions on short-selling and the asymmetry of information could be the roots of these inefficiencies.

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ENDNOTES

[1] See CHANCE and BROUGTHON (1988) and KING and REMOLONA (1987).

[2] See also BURTH et al. (2000).

[3] See HULL (2000).

[4] See WOHLWEND (2001), pp. 204–209 for details.

[5] WILCOXON (1945).

[6] First, the absolute difference is formed for each product and expressed as a percentage of the strike price of the structured product. After that, the arithmetic mean is calculated.

[7] See TOLLE et. al. (2005) and WOHLWEND (2001) for details.

[8] Nonetheless, the results concerning the various products are not aggregated, which means that any comparison with the results presented here must be treated with caution.

[9] In the group formed by the last 120 days prior to maturity, there is just one product amongst the "exotics" that has 19 differences in volatility. The value recorded for it is thus not representative.

[10] Nor is it possible to explain this positive difference in volatility in terms of possible distortions shortly before the product reaches maturity since the differences in volatility during the last two weeks were excluded from the analysis. For a discussion of the effects of the run-up to maturity in the Swiss options market, the reader is referred to STUCKI and WASSERFALLEN (1994).

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