THE JOURNAL OF FINANCE • VOL. XLIII, NO. 5 • DECEMBER 1988

Underpricing of Newly Issued Bonds: Evidence from the Swiss Capital Market

WALTER WASSERFALLEN and DANIEL WYDLER*

ABSTRACT

The pricing of newly issued bonds on the Swiss capital market is investigated over the years 1980–1982. The results reveal a slight underpricing of new bonds at the issue date that is roughly equal to the difference in transactions costs between the markets for new and seasoned bonds. Underpricing is no longer observed when the new bonds start to be traded on the stock exchange, that is, after about two days. Tests of several hypotheses show that unexpected changes in interest rates over the offering period explain part of the underpricing.

THE CAPITAL ACQUISITION PROCESS of firms has been the subject of intensive research in finance.[1] The pricing of newly issued securities is one of the central topics in this area. Several studies for the bond market find systematic and partly persistent underpricing and therefore higher returns for new bonds relative to seasoned bonds. The term "seasoning process" is generally used to describe this phenomenon.[2] Typically, yields to maturity or holding-period returns of either individual new bonds or portfolios of new bonds are compared to portfolios of existing bonds. So far, only data from the United States have been evaluated.

This study extends previous research by investigating observations from the Swiss capital market. Due to different institutional characteristics, various hypotheses can be tested in a more revealing way. In order to allow a reliable identification of the seasoning process, individual new and seasoned bonds are selected so that they are identical in as many relevant characteristics as possible. Holding periods are defined over shorter time spans than commonly used in the literature, leading to a more exact estimate of the persistence of systematic differences in returns.

The paper is organized as follows. The methodology underlying the empirical work is developed in Section I. Section II discusses the institutional setting and the data base. The empirical importance of the seasoning process is documented in Section III. Various explanations and their respective test results are presented in Sections IV and V. Some conclusions complete the paper.

* Study Center Gerzensee, Foundation of Swiss National Bank and Bank Pictet & Co., Geneva, respectively. The comments by J. Williams as well as by participants at the 13th Annual Meeting of the European Finance Association, Dublin 1986, are gratefully acknowledged. The unusually detailed suggestions by two referees resulted in a significant improvement of the paper.

[1] A survey is provided by Smith [12].

[2] Examples are Brimmer [2], Conard and Frankena [3], Ederington [4], Fung and Rudd [5], Lindvall [7], Sorensen [13], and Weinstein [14]. Weinstein [14] discusses the literature in detail. Alternatively, sticky prices of old bonds might account for this phenomenon. Empirically, we are not able to distinguish between the two hypotheses. Our interpretation of the evidence follows the literature.

I. Methodology

To measure the magnitude of the underpricing, we begin by defining the return over a holding period j as follows:

$$ {}_tR_{t+j} = (P_{t+j} - P_t)/P_t, \tag{1}$$

where P_{t+j} is the price of the bond at the end and P_t the price at the beginning of the period, both expressed in percentage points of the face value.[3] Prices are defined to include transactions costs and other cash payments associated with the bond. The resulting expressions for buying and selling prices are

$$P_t = (1 + k_1)(P'_t + c_t), \tag{2}$$

$$P_{t+j} = (1 - k_2)(P'_{t+j} + c_{t+j}) + C_j. \tag{3}$$

P'_t and P'_{t+j} are the prices quoted on the market; k_1 and k_2 denote transactions costs per unit of price for the buyer and the seller, respectively. Accrued interest since the last coupon payment, captured by c_t and c_{t+j}, is added to the price. C_j symbolizes a coupon payment over the relevant holding period. The measurement of the various magnitudes is discussed in the next section.

The relationships between the price of the old or seasoned bond, P_s, and that of the new bond, P_n, are given by

$$P_{st} = P_{nt} + \delta_t, \tag{4}$$

$$P_{st+j} = P_{nt+j} + \delta_{t+j}, \tag{5}$$

where δ is the measure of underpricing. In terms of returns, the following relations can be derived by combining equation (1) with equations (4) or (5):

$$\begin{aligned} {}_tR_{st+j} &= (P_{st+j} - P_{st})/P_{st} \\ &= (P_{nt+j} + \delta_{t+j} - P_{nt} - \delta_t)/(P_{nt} + \delta_t), \end{aligned} \tag{6}$$

$${}_tR_{nt+j} = (P_{nt+j} - P_{nt})/P_{nt}. \tag{7}$$

Solving equation (6) for δ_t and using equation (7) yields the relevant measure of underpricing at the beginning of the holding period:[4]

$$\delta_t = P_{nt}({}_tR_{nt+j} - {}_tR_{st+j})/(1 + {}_tR_{st+j}) + \delta_{t+j}/(1 + {}_tR_{st+j}). \tag{8}$$

We assume that the seasoning process of newly issued bonds is completed at the end of the holding period, implying that $\delta_{t+j} = 0$. If this condition is not met, δ_t will obviously be downward biased. We therefore consider holding periods of various lengths as shown in Section II.

Equation (8) contains a comparison between anticipated holding-period returns of new and seasoned bonds. Actual differences in returns have to be substituted for expected ones in empirical work. Under the assumption of rational expectations, the resulting measurement error, however, is purely random.

[3] This corresponds to the usual quotation on the stock exchange.

[4] In principle, δ_t could be directly calculated from equation (4). This procedure is not chosen because unavoidable differences in the characteristics of the bonds compared lead to considerably larger measurement errors in price than in return differences.

With the exception of Fung and Rudd [5] and Weinstein [14], yields to maturity are used instead of holding-period returns. On analytical grounds, the two procedures yield the same results. The more important difference lies in the choice of the seasoned bonds. According to our knowledge, bond indices (portfolios) published by specialized agencies have exclusively been used for that purpose. In some studies, the respective indices are chosen from the same rating class as the bond newly issued. Usually, characteristics other than default risk are therefore not controlled for. In this paper, we select a single seasoned bond for each new bond, trying to match as many relevant characteristics as possible. The details of this selection process are described in the next section.

II. Institutional Setting and Measurement Techniques

Over the sample period, the market for Swiss bonds features a number of unique institutional characteristics. First, contrary to the Eurobond market, no trading and, therefore, no valuation of new bonds take place in a gray market before the issue date. Second, various types of transaction costs are fixed through agreements among Swiss banks. Third, a large but not precisely known percentage of newly issued bonds is directly bought by individuals and institutions for their own portfolios, meaning that dealers play a relatively minor role in allocating new bonds to final investors.

Three procedures are used to issue new bonds. The first is direct placement by the borrower, which typically is done only by banks. The second procedure involves a syndicate of banks as underwriter that guarantees a prespecified price to the issuing firm and then sells the bonds at its own risk. Underwriting fees, fixed by a tariff, vary between 1.5 percent of the total face value for the Federal government and 3.5 percent for Swiss industrial corporations. These two procedures legally require that the selling price, the coupon rate, the term to maturity, and the total volume offered are specified in the offering prospectus. Printing and distribution of the prospectus plus a subscription period of about one week make it necessary that the above conditions are fixed about ten days prior to the issue date. The issuing firm and the intermediary therefore have to forecast capital market conditions on the issue date. If an issue is oversubscribed, the allocation is done by the underwriter. Bonds that cannot be placed must be taken over by the underwriter, who usually sells them afterwards in the secondary market. It is generally agreed among the parties involved that severely mispriced issues cannot be withdrawn.[5]

The third issuing procedure avoids these problems. It is organized as an auction and has so far almost exclusively been used by the Federal government. All conditions except the price are fixed in advance. By law, the specified quantity of bonds is then sold at a unique price to those investors making the highest offers. The actual price is finally fixed so that the total volume can be sold. A second round of bidding is not organized.

Two days after the issue date, new bonds are traded for the first time on an over-the-counter market organized by the regular stock exchange. Three to six

[5] The only common reason for withdrawal is a change in the official discount rate by the Swiss National Bank during the offer period.

months later, the new bonds become listed on the ordinary stock exchange.[6] Trade on the over-the-counter market is typically much more active than on the regular exchange. Below, we refer to both markets as secondary markets because there is no economic reason to differentiate between them.

Other relevant institutional arrangements concern accrued interest, c, coupon payments, C, and transactions costs, k_1 and k_2. The formula used to calculate c is the one actually applied in the market, e.g., $c = C(\tau/360)$, where τ is the time in days elapsed since the last coupon payment. In Switzerland, coupons are usually paid once a year. The reinvestment of coupon payments is not taken into account in our measures, but this effect is quantitatively unimportant given the very low level of interest rates over the period. At the issue date, the buyer pays neither fees nor taxes, making k_1 in equation (2) equal to zero. The minimal prescribed transactions costs on the secondary market, including fees as well as Federal and state taxes, imply that k_1 and k_2 in equations (2) and (3) are both equal to 0.002775 for some institutional investors, such as life insurance companies, and 0.00465 for private investors. These rates are independent of the volume transacted.[7]

The data base consists of all new bonds issued by Swiss debtors during the years 1980–1982, which are denominated in local currency and listed on the Zurich stock exchange.[8] A further requirement is that at least one transaction price is observed during the first three trading days. Floating rate- and equity-linked bonds are excluded. The resulting sample includes 328 issues of new straight bonds comprising a total volume of about thirty billion Swiss francs.[9]

Since the bonds are not rated by a rating agency, we distinguish five types of issuers according to quality criteria widely used in the market. The composition of the various classes and the respective sample sizes are shown in Figure 1. Class 1 consists of Federal government bonds, considered the least risky. Large public agencies compose the second class. Debtors with state guarantee and the four largest Swiss banks are included in class 3. The last two classes are somewhat more heterogenous and contain relatively few observations. As is done by Moody's and Standard & Poor's in the U.S., subordinated bonds are classified one category lower than ordinary bonds issued by the same debtor.

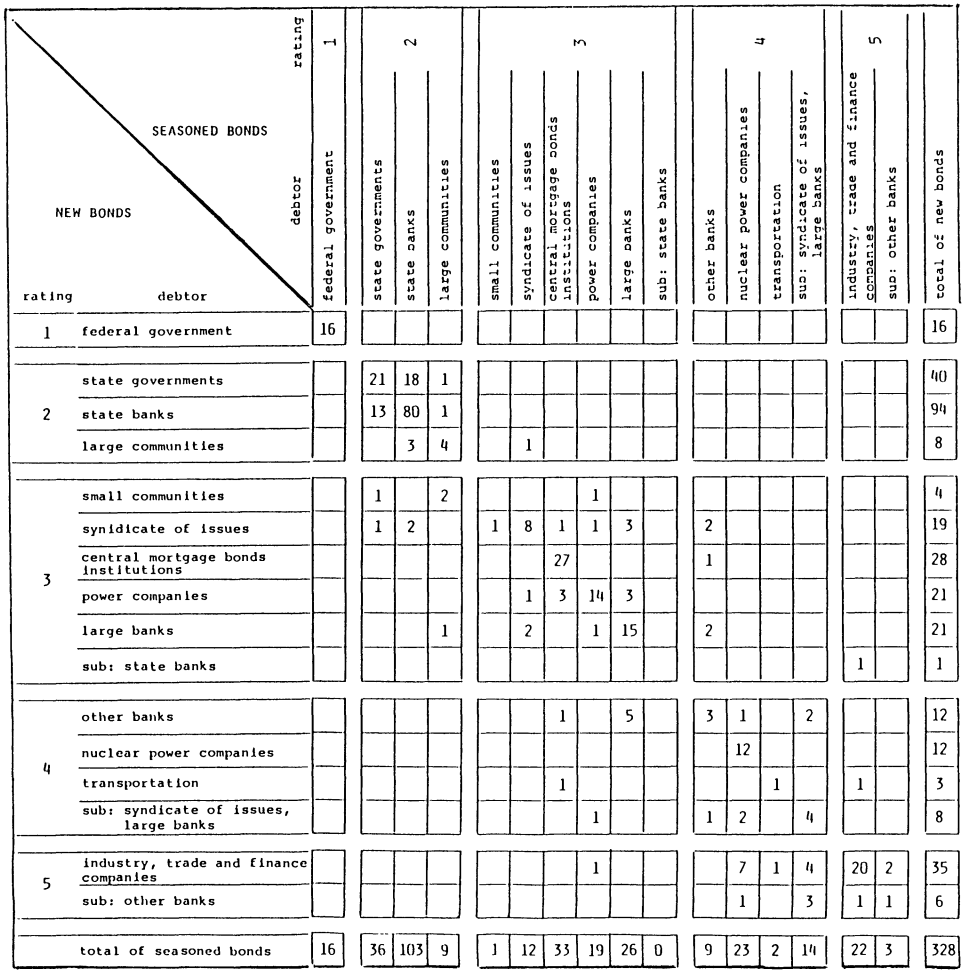
For each new bond, a seasoned bond is selected in order to measure the extent of underpricing. If possible, these reference bonds are chosen from the same debtor or at least from the same rating class. Figure 1 shows that this goal is achieved in 288 out of 328 cases (eighty eight percent). In addition, we tried to

[6] This delay occurs because official listing requires that the securities physically exist in printed form.

[7] On the domestic Swiss market, bid and ask prices are not actual transactions prices but only offers. Seller and buyer finally have to agree on a unique transactions price. Fees are therefore necessary to compensate traders for their services. This is contrary to the Eurobond market, where the marketmaker earns a bid-ask spread. The minimal transactions fees are prescribed in the so-called "courtage convention" agreed upon by banks in Switzerland. Since January 1986, a new agreement has contained minimal fees that no longer depend on the type of investor but on the amount transacted.

[8] Data are from the monthly bulletin of the Swiss National Bank, the Neue Zürcher Zeitung, and daily publications of the Zurich stock exchange.

[9] The trading volume of seasoned bonds is not available.



rating	NEW BONDS / SEASONED BONDS: debtor	1	2			3						4				5		total of new bonds
		federal government	state governments	state banks	large communities	small communities	syndicate of issues	central mortgage bonds institutions	power companies	large banks	sub: state banks	other banks	nuclear power companies	transportation	sub: syndicate of issues, large banks	industry, trade and finance companies	sub: other banks	
1	federal government	16																16
2	state governments		21	18	1													40
	state banks		13	80	1													94
	large communities			3	4		1											8
3	small communities		1		2				1									4
	syndicate of issues		1	2		1	8	1	1	3		2						19
	central mortgage bonds institutions							27				1						28
	power companies						1	3	14	3								21
	large banks				1		2		1	15		2						21
	sub: state banks															1		1
4	other banks							1		5		3	1		2			12
	nuclear power companies												12					12
	transportation							1						1		1		3
	sub: syndicate of issues, large banks								1			1	2		4			8
5	industry, trade and finance companies								1				7	1	4	20	2	35
	sub: other banks												1		3	1	1	6
	total of seasoned bonds	16	36	103	9	1	12	33	19	26	0	9	23	2	14	22	3	328

Figure 1. Sample of new and seasoned bonds. Underpricing of new bonds is evaluated by comparing individual new and seasoned bonds identical in as many characteristics as possible. Five rating classes are defined, each one including several subgroups of debtors. Risk increases from class 1 to class 5. Entries give the number of combinations of new and seasoned bonds in the sample with respect to rating and debtor class.

minimize differences in coupon rates, i, term to maturity, m, and terms to the first possible call date, m_c, across the bonds compared.[10] The relevant information on the sample is shown in Table I. The differences between the new and the seasoned bonds are generally quite small, especially if data restrictions due to the relatively low number of outstanding issues and the sometimes rather thin trading in the Swiss market are taken into account. The evidence in Section V shows that these differences do not prevent a reliable identification of an eventual seasoning process.

[10] Tax differences between capital gains and ordinary interest income might also affect the relative desirability of a new (current coupon) versus an old bond. This element cannot be taken into account because tax laws differ widely in this respect among Swiss cantons (states) as well as internationally.

Table I

Characteristics of New and Seasoned Bonds[a]

Characteristic	Mean[b]	σ[c]	min[d]	max[e]
Term to maturity (years)				
New bond	11.21	1.71	7.03	15.11
Seasoned bond	10.93	1.65	6.64	14.89
Difference	0.28	0.80	−2.39	4.13
Term to first possible call (years)				
New bond	8.91	1.08	6.02	12.07
Seasoned bond	8.51	1.10	5.66	11.66
Difference	0.39	0.65	−1.63	4.97
Coupon rate (%)				
New bond	5.45	0.67	4.00	7.50
Seasoned bond	5.19	0.78	2.75	7.50
Difference	0.26	0.76	−2.00	2.50

[a] The sample includes 328 bonds newly issued in Switzerland over the period 1980–1982.

[b] Mean: Cross-sectional average of the various characteristics for new bonds, seasoned bonds, and the difference between the respective new and seasoned bonds.

[c] σ : Standard deviation of the various characteristics.

[d] min: Lowest value of the various characteristics.

[e] max: Highest value of the various characteristics.

The underpricing measure given by equation (8) is calculated for a variety of simulated investment strategies. All strategies involve the purchase of the new bond on the issue date. Sale respectively occurs on the first trading day of the new bond (strategy 01), the second trading day (strategy 02), the third trading day (strategy 03), six months after the issue date (strategy 04), and one year after the issue date (strategy 05). Nine strategies involving only transactions on the secondary market have also been investigated, but no evidence of a seasoning phenomenon could be detected. These results are therefore not shown.

The quoted prices, P', entering formula (8) are the following: The price at the issue date is the offering price. Prices for new bonds observed during the first three trading days are actual transactions prices. Observations six months and one year after the issue date are sometimes arithmetic averages between the quoted bid and ask prices. The same holds with respect to all quotations for seasoned bonds. Thin trading furthermore creates some difficulties in keeping the length of the holding periods constant across bonds. The respective variations are two to five business days for strategy 01, three to seven business days for strategy 02, four to eight business days for strategy 03, five to seven months for strategy 04, and eleven to thirteen months for strategy 05. If no prices are available during these time intervals, the observations must be dropped. As a consequence, sample sizes vary slightly depending on the investment strategy considered.

III. The Empirical Importance of Underpricing

The relevant information on underpricing with respect to private and institutional investors is presented in Table II. Positive underpricing means that the

Table II

The Extent of Underpricing[a]

	1980–1982			1980			1981			1982		
Strategy[b]	μ[c]	t[d]	n[e]	μ	t	n	μ	t	n	μ	t	n
Private investors												
01	0.46	6.27	328	0.49	4.05	113	0.05	0.44	96	0.78	5.80	119
02	0.50	6.81	324	0.44	3.92	110	0.17	1.32	95	0.81	6.30	119
03	0.53	6.75	320	0.47	3.64	108	0.17	1.16	93	0.86	6.83	119
04	0.45	3.49	325	0.64	2.85	113	0.20	0.75	94	0.45	2.47	118
05	0.37	2.77	315	0.80	2.81	112	−0.03	−0.11	86	0.27	1.69	117
Institutional investors												
01	0.28	3.74	328	0.30	2.49	113	−0.14	−1.15	96	0.59	4.40	119
02	0.31	4.25	324	0.25	2.23	110	−0.02	−0.13	95	0.63	4.84	119
03	0.34	4.35	320	0.29	2.19	108	−0.02	−0.10	93	0.67	5.33	119
04	0.26	2.06	325	0.46	2.05	113	0.02	0.06	94	0.27	1.47	118
05	0.20	1.44	315	0.62	2.18	112	−0.21	−0.84	86	0.09	0.55	117

[a] The sample includes 328 bonds newly issued in Switzerland over the period 1980–1982. Private investors pay higher transactions costs on the secondary market than institutional investors.

[b] Strategy: Simulated holding periods over which underpricing is evaluated. Purchase occurs on the issue date for all strategies. Sale respectively occurs on the first trading day of the new bond (strategy 01), the second trading day (strategy 02), the third trading day (strategy 03), six months after the issue date (strategy 04), and one year after the issue date (strategy 05).

[c] μ: Average underpricing of new bonds relative to comparable seasoned bonds, essentially defined as the cross-sectional mean of return differences in percentage points over the holding periods defined in footnote b. Underlined coefficients are significantly different from zero at the five percent level.

[d] t: t-Value for μ.

[e] n: Sample size.

new bond sells at a lower price than the comparable seasoned bond. Significant underpricing only exists for strategies involving a purchase of the bond at the issue date.[11] The independence of the coefficients from the length of the investment period indicates that underpricing occurs only on the primary market. This finding is confirmed by the absence of underpricing for strategies involving the purchase of the new bond on the secondary market.

For private investors, new bonds are, on average over the total period, between 0.4 and 0.5 percentage points cheaper than seasoned bonds, measured relative to the face value. For institutional investors paying lower transactions costs, the underpricing declines to about 0.3 percentage points but remains significant. For both categories, this is almost exactly equal to the difference in transactions costs between the primary and the secondary markets, meaning that this institutional characteristic is exclusively to the advantage of the investor. The underpricing does not imply that arbitrage profits can be earned by buying new bonds at the issue date and selling them after a few days. Empirically, it is mostly the case that such strategies generate negative returns because transactions costs on the secondary market are too high relative to price changes.

[11] The distributions of the underpricing measures are generally leptokurtic relative to the normal. The significance levels are therefore somewhat overstated.

The breakdown according to calendar time, also contained in Table II, shows that significant underpricing occurs only in 1980 and 1982 but not in 1981. It is furthermore higher in 1982 than in 1980. This is a first indication that the underpricing depends on economy-wide movements in interest rates. In 1981, interest rates were mainly rising, implying a decline in bond prices. Since the selling price of the new bond has to be fixed about ten days prior to the issue date, an unexpected increase in interest rates over that time span lowers the price of bonds traded in the market and thus lowers the degree of underpricing.[12] Exactly opposite conditions—falling interest rates—prevailed in 1982, whereas interest rates moved in both directions in 1980. This hypothesis will be more carefully examined in the next two sections.

Table III contains the underpricing measures, calculated over the whole period, with respect to the rating classes distinguished in the previous section. With some exceptions, the findings for the total sample are also relevant for each rating class separately. New bonds are generally underpriced when they are bought at the issue date. Some features of the results are, however, rather unexpected. The underpricing seems to be larger for debtors in rating classes 2 and 3, who generally have more experience with respect to issuing bonds. For ratings 4 and 5, the effect is positive but statistically insignificant. A possible explanation might be that underwriting fees, as given by the rigid tariff described above, are generally the highest for these classes of debtors. Less underpricing is a way to reduce the compensation for the underwriter to a competitive level. A further investigation of this hypothesis is precluded because precise data on issuing costs are not available. Surprisingly, the underpricing cannot be totally avoided through the auction procedure used by the Federal government (rating 1). A more detailed analysis of this issue is undertaken in Sections IV and V.

Our results correspond to the ones found for the U.S. by Fung and Rudd [5] and Weinstein [14], who also use holding-period returns. Weinstein [14], for example, reports that new bonds yield a monthly excess return of 0.383 percentage points for the first month after the issue date and nothing thereafter. The differences in yields to maturity of fifteen to thirty basis points shown by Conard and Frankena [3], Ederington [4], and Lindvall [7] imply higher underpricing at the issue date.

IV. Hypotheses

Three broad hypotheses for underpricing can be distinguished. The first and most relevant one for this study is based on the price-setting policy chosen by the issuer. The second deals with several forms of market imperfection due to transactions costs, and the third relies on the heterogeneity of the new and seasoned bonds whose performances are compared. The exact measurement of the various explanatory variables is given below Table IV.

[12] Most variations in interest rates are probably unanticipated because the random-walk model provides a good approximation to observed time series.

Table III

Underpricing by Rating Classes (Private Investors)[a]

	Strategy[b]				
	01	02	03	04	05
Rating 1					
μ[c]	0.40	0.42	0.41	0.08	0.15
t[d]	3.20	3.56	3.47	0.28	0.38
n[e]	16	16	16	16	16
Rating 2					
μ	0.52	0.61	0.60	0.37	0.34
t	5.30	6.06	5.78	1.87	1.53
n	142	139	137	139	129
Rating 3					
μ	0.54	0.62	0.73	1.06	0.84
t	4.50	5.08	5.12	5.21	3.64
n	94	93	93	94	94
Rating 4					
μ	0.38	0.13	0.22	0.32	−0.08
t	0.94	0.39	0.63	0.68	−0.21
n	35	35	35	35	35
Rating 5					
μ	0.21	0.19	0.11	−0.45	−0.11
t	0.98	0.82	0.45	−1.15	−0.25
n	41	41	39	41	41

[a] The sample includes 328 bonds newly issued in Switzerland over the period 1980–1982. Risk increases from rating 1 to 5. Private investors pay higher transactions costs on the secondary market than institutional investors (results not shown).

[b] Strategy: Simulated holding periods over which underpricing is evaluated. Purchase occurs on the issue date for all strategies. Sale respectively occurs on the first trading day of the new bond (strategy 01), the second trading day (strategy 02), the third trading day (strategy 03), six months after the issue date (strategy 04), and one year after the issue date (strategy 05).

[c] μ: Average underpricing of new bonds relative to comparable seasoned bonds, essentially defined as the cross-sectional mean of return differences in percentage points over the holding periods defined in footnote b. Underlined coefficients are significantly different from zero at the five percent level.

[d] t: t-Value for μ.

[e] n: Sample size.

Three different aspects of price-setting behavior are potentially relevant in explaining the underpricing. They are as follows:

1. *Forecasting errors by the issuer.* Interest rates over the offer period have to be forecasted because the price of the new bond has to be fixed about ten days before the issue date.[13] An unforeseen decrease in interest rates over this period increases the price of the seasoned bond and therefore results in an underpricing

[13] Auctions are, of course, an exception.

Table IV

Regression Results (Underpricing for Private Investors)[a]

Exogenous Variables[c]	Strategy[b] 01	02	03	04	05
C	−0.96	−1.63	−1.76	0.61	2.44
	(−0.93)	(−1.62)	(−1.57)	(0.32)	(1.19)
Dy	−8.29	−8.55	−7.85	−3.72	−5.65
	(−8.48)	(−8.95)	(−7.33)	(−2.07)	(−2.92)
m_n	0.10	0.10	0.10	0.11	0.14
	(2.05)	(2.18)	(1.90)	(1.30)	(1.50)
i_n	−0.41	−0.41	−0.23	−0.50	−0.36
	(−1.71)	(−1.76)	(−0.89)	(−1.13)	(−0.78)
σ_y	−0.37	−0.03	−0.49	−2.90	0.36
	(−0.26)	(−0.02)	(−0.31)	(−1.10)	(0.13)
K	0.06	0.00	0.10	0.07	0.27
	(0.41)	(−0.01)	(0.60)	(0.23)	(0.87)
V_n	0.09	−0.13	−0.26	0.27	−0.08
	(0.44)	(−0.64)	(−1.14)	(0.71)	(−0.19)
Di	0.05	−0.02	−0.07	0.11	0.46
	(0.45)	(−0.21)	(−0.60)	(0.52)	(2.11)
y	0.52	0.68	0.54	0.31	−0.36
	(1.63)	(2.18)	(1.57)	(0.53)	(−0.56)
Dm	−0.19	−0.06	−0.09	−0.15	−0.28
	(−1.80)	(−0.61)	(−0.79)	(−0.77)	(−1.32)
adj. R^{2d}	0.22	0.24	0.18	0.01	0.04
n^e	288	284	280	286	275

[a] The sample includes 328 bonds newly issued in Switzerland over the period 1980–1982. Data from auctions are excluded. Private investors pay higher transactions costs on the secondary market than institutional investors (results not shown). Entries are regression coefficients, with t-values in parentheses. Underlined coefficients are significantly different from zero at the five percent level.

[b] Strategy: Simulated holding periods over which underpricing is evaluated. Purchase occurs on the issue date for all strategies. Sale respectively occurs on the first trading day of the new bond (strategy 01), the second trading day (strategy 02), the third trading day (strategy 03), six months after the issue date (strategy 04), and one year after the issue date (strategy 05).

[c] Exogenous variables are defined as follows:

C: Constant term.

Dy: Difference of the yield to maturity of Federal government bonds at the most recent Friday before the issue date and the yield one week before (%).

m_n: Term to maturity of the new bond (years).

i_n: Coupon rate of the new bond (%).

σ_y: Standard deviation of the yields to maturity of Federal government bonds over five Fridays before the end of the offer period (%).

K: Dummy variable with a value of one for underwritten issues and zero otherwise.

V_n: Total volume of the new bond (face value) minus the volume of old maturing bonds which can be converted into new bonds of the same debtor (100 million Swiss francs).

Di: Difference between the coupon rates of the new and the seasoned bonds (%).

y: Yield level at the issue date measured as the average of the yields to maturity of Federal government bonds over the five Fridays before the issue date (%).

Dm: Difference between the term to maturity of the new bond and the remaining term to maturity of the seasoned bond (years).

[d] *adj.* R^2: R^2, adjusted for degrees of freedom.

of the new bond. The change in the yield to maturity on an index of Federal government bonds over the offer period, Dy, is taken as a proxy. Since it is well known that long-term interest rates approximately follow random walks, Dy is a good measure of their unanticipated component.[14]

2. *Costs of the failure of an issue.* If failure is costly, the issuer will try to reduce the probability of failure by offering a price discount for new bonds, which has the function of a risk premium. Conard and Frankena [3] accordingly call it the risk hypothesis. The probability of a failure, therefore the extent of underpricing, is positively related to the variability of interest rates immediately prior to the issue date, σ_y, and the quantitative reaction of prices of new bonds with respect to unexpected changes in interest rates. The latter effect is a positive function of the duration of the bond, which is positively influenced by its term to maturity, m_n, and negatively by its coupon rate, i_n.[15]

3. *Imperfect competition among underwriters.* The issuer is interested in a higher bond price than the underwriter because the latter guarantees a prespecified price to the debtor and therefore bears the risk of a failure.[16] If banks form a cartel, they should be able to impose lower than competitive prices on the issuer. This effect, however, should not be observed for direct placements by the debtor. The dummy variable K, taking a value of one for underwritten issues and zero otherwise, is used to test this hypothesis.

Various forms of market imperfection, such as informational asymmetries or differential transactions costs and taxes, may also generate an underpricing of new bonds. These market imperfections imply that new and seasoned bonds with similar return characteristics are priced differently. Such explanations can also account for a seasoning process that takes time to be completed. Tests of market imperfections are difficult to implement. Two possibilities are investigated. First, the usual price-pressure hypothesis is tested. It states that investors are only willing to absorb a large volume of new bonds if a price discount is offered because the necessary portfolio reallocations involve transactions costs. The total face value of the debt, V_n, is therefore included in the regressions. Second, the characteristics of different issuing procedures provide additional test opportunities. Specifically, the auctions used for new Federal bonds imply that the seller can choose the prices offered to him or her by the demand side of the market. Underpricing of auctioned bonds might therefore indicate some form of market imperfection.

The last category of hypotheses deals with the heterogeneity of the bonds compared and therefore with measurement problems. Price differences may be observed if the new and seasoned bonds are not perfect substitutes because they differ with respect to one or more relevant characteristics. This explanation is independent of the distinction between the primary and the secondary market. In the regressions presented in the next section, two sources of heterogeneity are investigated. The first is connected to the existence of a call provision, implying

[14] A theoretical rationale and a brief summary of the evidence are contained in Pesando [10].

[15] The duration of a bond is a measure of its effective lifetime involving adjustments for coupon payments. For a summary of the relative literature, the reader is referred to Bierwag, Kaufman, and Khang [1]. The discussion in the text is based on the measure developed by Macaulay [8].

[16] Contractual agreements usually restrict this risk for the underwriter.

that price differentials between new and seasoned bonds should be positively related to the difference in their coupon rates, *Di*, and to the interest rate at the time of the issue, y.[17] Second, the difference in the term to maturity, *Dm*, is included as an explanatory variable. Differential debtor quality may also influence the relative performance of the new and seasoned bonds, but various investigations show that this effect is statistically unimportant in our sample.[18]

V. Empirical Results

Cross-sectional regressions are used to relate the observed underpricing to the explanatory variables discussed in Section IV. Differences in the extent of underpricing according to the issuing technique provide additional possibilities for discriminating between hypotheses. The cross-sectional regressions, estimated by ordinary least squares, are presented in Table IV.[19] The underpricing for private investors is chosen as the dependent variable. The results obtained for institutional investors are, however, essentially the same. Data for bonds issued by the Federal government through the auction procedure are excluded from the sample because the hypotheses outlined in the previous section are mainly relevant for procedures involving offer prices fixed in advance.

The only variable exhibiting a significant influence in the hypothesized direction is the unexpected change in the level of interest rates during the offer period, proxied by *Dy*. The necessity to forecast interest rate movements seems to be the most important problem in establishing an appropriate offer price.

The risk hypothesis also gets some support. The term to maturity, m_n, has the hypothesized positive influence, with three out of five coefficients being significant. As expected, the coupon rate of the new bond, i_n, is negatively related to underpricing, but the associated t-statistics do not indicate significance at the five percent level. No effect of the risk term σ_y can be found.

The cartel hypothesis is rejected given the unimportance of the dummy variable K. The same conclusion can be drawn with respect to the price pressure term V_n and the variables measuring heterogeneity of the bonds compared, e.g., *Di*, *y*, and *Dm*.

The robustness of the regression results has been checked through a variety of procedures. Separate regressions for each of the years 1980 to 1982 essentially confirm the results found for the total period. *Dy* exerts an especially strong negative influence in all three years. This continues to be the case if the sample is stratified according to rating classes or issuing procedures. Multicollinearity may be another source of problems. The absolute value of estimated pairwise correlations among the exogenous variables is generally below 0.4. The coefficient between the coupon rate on new bonds, i_n, and the change in interest rates, *Dy*,

[17] Conard and Frankena [3] and Ederington [4], for example, explain a major part of the underpricing by the difference in premia between new and seasoned bonds associated with the call provision.

[18] The underpricing is almost exactly the same whether debtors compared have equal rating, belong to the same type of institution, or are in fact identical.

[19] The various estimates are obviously not independent of each other.

Table V

Underpricing for Different Issuing Procedures[a]

	All Issues			Direct Placements			Underwritten Issues			Auctions		
Strategy[b]	μ[c]	t[d]	n[e]	μ	t	n	μ	t	n	μ	t	n
Private investors												
01	0.46	6.27	328	0.46	4.94	162	0.48	3.76	149	0.38	3.17	17
02	0.50	6.81	324	0.52	5.55	159	0.49	3.91	148	0.39	3.39	17
03	0.53	6.75	320	0.50	5.08	158	0.58	4.25	145	0.38	3.36	17
04	0.45	3.49	325	0.43	2.41	161	0.50	2.47	147	0.12	0.46	17
05	0.37	2.77	315	0.29	1.56	151	0.48	2.25	147	0.19	0.51	17
Institutional investors												
01	0.28	3.74	328	0.27	2.94	162	0.29	2.29	149	0.19	1.59	17
02	0.31	4.25	324	0.33	3.57	159	0.30	2.42	148	0.20	1.75	17
03	0.34	4.35	320	0.31	3.18	158	0.39	2.86	145	0.20	1.71	17
04	0.26	2.06	325	0.25	1.39	161	0.31	1.56	147	−0.06	−0.23	17
05	0.20	1.44	315	0.11	0.61	151	0.30	1.42	147	0.01	0.03	17

[a] The sample includes 328 bonds newly issued in Switzerland over the period 1980–1982. Private investors pay higher transactions costs on the secondary market than institutional investors.

[b] Strategy: Simulated holding periods over which underpricing is evaluated. Purchase occurs on the issue date for all strategies. Sale respectively occurs on the first trading day of the new bond (strategy 01), the second trading day (strategy 02), the third trading day (strategy 03), six months after the issue date (strategy 04), and one year after the issue date (strategy 05).

[c] μ: Average underpricing of new bonds relative to comparable seasoned bonds, essentially defined as the cross-sectional mean of return differences in percentage points over the holding periods defined in footnote b. Underlined coefficients are significantly different from zero at the five percent level.

[d] t: t-Value for μ.

[e] n: Sample size.

is the exception, with a magnitude of 0.86. The regression results do not, however, change if either i_n or Dy is omitted. A standard Glejser test for heteroscedasticity reveals some significant deviations from the standard OLS assumptions.[20] The resulting biases in the estimated covariance matrix of the parameters are apparently small because the empirical findings remain the same if the correction proposed by White [15] is used.

Based on the above results, it can be concluded that the price-setting behavior of issuers, especially the necessity to anticipate market conditions, explains part of the observed underpricing. This explanation is, however, not relevant for bonds issued via the auction procedure. Table V reveals that the extent of underpricing is indeed smaller in this case but does not vanish completely. Short-term trading strategies imply an underpricing of new bonds that remains statistically significant in the case of private investors.

Several possible explanations may account for this finding. First, investors may want to be compensated for transactions costs arising from the need to

[20] The absolute values of the residuals from an OLS regression are regressed on each exogenous variable separately. See Judge, Griffiths, Hill, and Lee [6, pp. 145–46] for details.

reallocate portfolios when large amounts of new bonds are purchased. Second, under all issuing procedures, the allocation of new bonds is uncertain. If an issue is oversubscribed, the investor may receive far less than the quantity desired or even nothing. Undersubscription, generally the result of overpriced bonds, can occur only if the underwriting procedure or a direct placement is used. On average, a slight underpricing of new bonds may be needed in order to compensate buyers for this allocation risk.[21] Unfortunately, an empirical investigation of these hypotheses proved to be impossible because data on transactions costs, the degree of over- or undersubscription, and the rationing procedures used in the case of excess demand are not available.

VI. Conclusion

Underpricing of newly issued bonds in Switzerland over the years 1980–1982 is investigated. The results reveal a slight underpricing at the issue date that is roughly equal to the difference in transactions costs between the markets for new and seasoned bonds. No underpricing is observed on the secondary market. Unexpected changes in interest rates over the offering period explain part of the underpricing.

[21] Parsons and Raviv [9] and Rock [11] develop formal models along these lines that are based on informational asymmetries across groups of market participants. This specific reason seems, however, not to be very relevant in the market for Federal government bonds.

REFERENCES

1. Gerald O. Bierwag, George G. Kaufman, and Chulsoon Khang. "Duration and Bond Portfolio Analysis: An Overview." *Journal of Financial and Quantitative Analysis* 13 (November 1978), 671–81.
2. Andrew F. Brimmer. "Credit Conditions and Price Determination in the Corporate Bond Market." *Journal of Finance* 15 (September 1960), 353–70.
3. Joseph W. Conard and Mark W. Frankena. "The Yield Spread between New and Seasoned Corporate Bonds, 1952-63." In J. Guttentag and P. Cagan (eds.), *Essays on Interest Rates,* vol. 1. New York: National Bureau of Economic Research, 1969, 143–222.
4. Louis H. Ederington. "The Yield Spread on New Issues of Corporate Bonds." *Journal of Finance* 29 (December 1974), 1531–43.
5. W. K. H. Fung and Andrew Rudd. "Pricing of New Corporate Bond Issues: An Analysis of Issue Cost and Seasoning Effects." *Journal of Finance* 41 (July 1986), 633–44.
6. George G. Judge, William E. Griffiths, R. Carter Hill, and Tsoung-Chao Lee. *The Theory and Practice of Econometrics.* New York: John Wiley & Sons, 1980.
7. John R. Lindvall. "New Issue Corporate Bonds, Seasoned Market, Efficiency, and Yield Spreads." *Journal of Finance* 32 (September 1977), 1057–67.
8. F. R. Macaulay. *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856.* New York: National Bureau of Economic Research, 1938.
9. John E. Parsons and Artur Raviv. "Underpricing of Seasoned Issues." *Journal of Financial Economics* 14 (September 1985), 377–97.
10. James E. Pesando. "On the Random Walk Characteristics of Short- and Long-Term Interest Rates in an Efficient Market." *Journal of Money, Credit and Banking* 11 (November 1979), 457–66.

11. Kevin Rock. "Why New Issues Are Underpriced." *Journal of Financial Economics* 15 (January/February 1986), 187–212.
12. Clifford W. Smith Jr. "Investment Banking and the Capital Acquisition Process." *Journal of Financial Economics* 15 (January/February 1986), 3–29.
13. Eric H. Sorensen. "On the Seasoning Process of New Bonds: Some Are More Seasoned Than Others." *Journal of Financial and Quantitative Analysis* 17 (June 1982), 195–208.
14. Mark I. Weinstein. "The Seasoning Process of New Corporate Bond Issue." *Journal of Finance* 33 (December 1978), 1343–55.
15. Halbert White. "Instrumental Variables Regression with Independent Observations." *Econometrica* 50 (March 1982), 483–99.