FINANCIAL SERVICES REVIEW

Financial Services Review 14 (2005) 305–318

Do equity-linked certificates of deposit have equity-like returns?

Michelle Edwards[a], Steve Swidler[b,*]

[a]*University of Nebraska-Lincoln, Lincoln, NE 68588-0491, USA*
[b]*Department of Finance, Auburn University, Auburn, AL 36849, USA*

Abstract

In recent years, equity-linked certificates of deposit (ELCDs) have become widely available to investors as banks strive to remain competitive. Banks sell these instruments as having the safety of a traditional CD with potential market-like returns. However, valuing these instruments can be difficult because the terms vary and the returns depend upon future market conditions. This paper uses Monte Carlo simulation to examine their return distribution. While individuals might find the typical ELCD a more attractive instrument than a 5-year Treasury note, a synthetic ELCD consisting of a zero-coupon bond and stock index call option may be an even more appealing investment. © 2005 Academy of Financial Services. All rights reserved.

JEL classifications: G11; G13; G21

Keywords: Certificates of deposit; Financially engineered investment

1. Introduction

Equity-linked certificates of deposit (ELCDs) are securities with interest rates based on the performance of one of the market indices such as the S&P 500, the Dow Jones Industrial Average, or the NASDAQ composite index. Chase Manhattan Bank first introduced ELCDs in 1987, but they have recently become more widely available under a variety of terms. Banks market ELCDs to the investor as a product to compete with mutual funds and other equity investments. The marketing literature describes the hybrid instruments as having the

* Corresponding author. Tel.: +1-334-844-3014; fax: +1-334-844-4960.
E-mail address: swidler@auburn.edu (S. Swidler).

safety of a traditional CD, with the potential to earn higher returns associated with more risky stock market investments.

Bank deregulation has significantly changed the competitive landscape in the industry over the past two decades. With increased competition, mergers have caused the number of federally insured commercial banks and savings institutions to fall from 15,435 in 1990 to 8,975 in 2004 (FDIC, 2004). To remain competitive with other financial institutions, banks continually develop new savings products such as ELCDs to attract depositors. However, the hybrid nature of ELCDs may make it difficult for investors to understand the risk and return characteristics of the security. Thus, this study attempts to answer whether ELCDs have equity-like returns and more generally examines the security's return distribution.

The analysis compares the performance of a typical 5-year ELCD available through commercial banks to the returns of a 5-year investment in the S&P 500. The study also considers the implicit ELCD components, a zero-coupon bond and call option on the S&P 500 index, and examines their joint returns. After completing an historical analysis, we perform a Monte Carlo simulation to show the expected returns of each instrument.

2. History of the equity-linked certificate of deposit

Chase Manhattan Bank of New York was the first to offer an equity-linked CD in March 1987, and at least nine other large banks followed suit that year in an effort to tap the booming equity markets (Abken, 1989). Initially, only the larger, sophisticated banks had the expertise to manage the risks associated with offering these nontraditional CDs. Now, more than a decade later, financial intermediaries make variations of the ELCD available through community banks.

Baubonis, Gastineau and Purcell (1993) review the terms offered by five large banks in 1992, describe the mechanics of an ELCD, and discuss the hedging actions for the issuer.[1] They examine historical returns of the S&P 500 and a hypothetical ELCD based on data from 1948 to 1993. They find that the ELCD earns an average annual return of 8.33% compared to the average return of the S&P 500 at 9.93%. Baubonis et al. (1993) state ELCDs "provide what many investment advisors consider an attractive risk and return profile relative to a straight equity mutual fund investment, a money market CD, or an intermediate-term fixed-income fund investment." This statement may be misleading since retail versions of the ELCDs generally do not yield the kind of results reported in their analysis.

Since the mid 1990s, equity-linked CDs have been referred to as index-linked CDs, market index-linked CDs, and one financial firm has registered their product calling it the Index Powered CD (IPCD). Regardless of what they are called, the products offer variations on the same fundamental elements. The CDs may vary by maturity (five years, six years, etc.), participation rate (some offer 100% of the increase in the market index, others only 90%), and the method of computing the return of the stock index (some use an averaging method to determine the ending value of the index level, while others use the final index value). Some CDs tie returns to the S&P 500, others to the Dow Jones Industrial Average, whereas still others to a popular stock index such as the NASDAQ 100. Some offer a minimum coupon rate, while others do not, guaranteeing only the return of invested principal. Moreover, the minimum required deposit varies from issue to issue.

Understanding any equity-linked CD requires knowledge of the unique terms offered and a realization that returns depend upon future market conditions. The variables affecting the investment return can be summarized as follows: time to maturity, participation rate, market index, guaranteed coupon rate, and minimum deposit. These are the ELCD characteristics that must be evaluated by the investor along with his or her future market expectations.

3. Performance analysis of a representative ELCD

To examine whether equity-linked CDs have equity-like returns, we consider a representative ELCD offered in the marketplace. Index Powered Financial Services, LLC (IPFS) is a third party company that manages ELCDs for community banks. They first issued their product, the IPCD, in January 2001. The terms of the IPCD are $1,000 initial investment, five years to maturity, return of principal is guaranteed, and interest equal to 90% of the increase of the average closing value of the last 12 quarters of the S&P 500.

Alternatively, we construct a portfolio that reflects the basic features of an ELCD. Consider an investor who wants to invest $1,000 with no risk of losing principal and the opportunity to earn market-like returns. This investor might purchase a zero-coupon bond and an at-the-money call option on the S&P 500 market index. The investor buys the zero-coupon bond at a discount and receives the $1,000 bond par value at maturity. She then uses the difference between the $1,000 investment and the price of the zero-coupon bond to pay for the call option premium. By purchasing a call option with expiration the same as the time to maturity of the bond, the investor has, in effect, created a synthetic ELCD. If, at maturity, the S&P 500 has increased, the investor exercises the call option and earns a return on the capital gains portion of the S&P 500. If the S&P 500 decreases, the investor does not exercise the option and receives nothing for it. However, the investor still receives the face value of the bond thereby insuring the original $1,000 investment.

There is the possibility that the difference between $1,000 and the price of the zero-coupon bond is not large enough to pay for the at-the-money call option on the S&P 500 index. In that case, the investor would only be able to purchase a fraction of the call option and would, therefore, earn less than any capital gain in the stock market. A complete discussion of ELCD returns when market participation is less than 100% appears in the section on simulation results.

We begin the analysis by comparing historical rates of return for the different financial instruments. Although traditional certificates of deposit have been available since 1961, our period of analysis starts with the first quarter of 1981 and ends in the fourth quarter 2004. The choice of a 1981 starting date is to coincide with the beginning of bank deregulation in the U.S. Moreover, the period of 1981 through 2004 is long enough to include several business cycles and the stock market crash in 1987.

For each product in our analysis, we compute an annualized rate of return based on a 5-year (20-quarter) holding period. We first consider historical returns for the S&P 500 and calculate the 5-year return as:

$$R_{5yrS\&P} = \left[\prod_{q=1}^{20} (1 + r_q) \right] - 1 \tag{1}$$

where r_q is the return to the S&P 500 in quarter q inclusive of index dividends. A geometric average is then computed to yield the annualized rate of return:

$$AR_{S\&P} = (1 + R_{5yrS\&P})^{0.2} - 1 \tag{2}$$

Finally, given our sample of 96 quarters, we can estimate returns for 76 overlapping 5-year periods.

We next calculate historical returns on the IPCD using the same 96 quarters. To calculate the IPCDs 5-year holding period return, $R_{5yr/PCD}$, it is necessary to calculate the average of the S&P 500 using the index values at the end of the last 12 quarters and adjust for a market participation rate of 90%:

$$R_{5yrIPCD} = 0.9\left(\frac{\bar{P} - P_0}{P_0}\right) \quad \text{if} \quad \frac{\bar{P} - P_0}{P_0} > 0 \tag{3a}$$

and

$$R_{5yrIPCD} = 0 \text{ if } \quad \frac{\bar{P} - P_0}{P_0} < 0 \tag{3b}$$

where $\bar{P} = \frac{\sum_{q=9}^{20} P_q}{12}$, P_q = the index value at the end of quarter q, and P_0 = the index value at the time the IPCD was issued. The return can again be annualized by taking the geometric mean. Note that in the case of the IPCD, returns based on the S&P 500 index do not include any dividends paid by the underlying stocks.

Finally, the historical returns of the synthetic ELCD involve computing the discount price of a zero-coupon bond, estimating the call premium on the S&P 500 index, compounding interest on any excess funds, and determining the option's intrinsic value at expiration. The ELCDs final value is the sum of the bond's par value, the dollar return to the option and earned interest on any excess funds. Thus, to calculate the synthetic ELCD return, we must consider each of the individual components.

To compute the price of the synthetic ELCDs zero-coupon bond, P_B, we discount the CD's $1000 par value by r_f, the annual yield to maturity on a 5-year Treasury note:

$$P_B = \frac{1000}{(1 + r_f)^5}\,. \tag{4}$$

The analysis uses the 5-year constant maturity Treasury note obtained from the Federal Reserve Board. Next, to adjust for transaction fees associated with purchasing the discount bond and index call option, we subtract 2.5% ($25.00) of the par value of the ELCD. The discount, less the transaction fee, can then be used to invest in the S&P 500 index call option.

To determine the fair market value of the at-the-money call, we use Merton's (1973) option pricing model that adjusts for a continuous dividend yield. The source for S&P 500 dividends is Thompson's Financial DataStream, and we again use the 5-year Treasury note yield for the risk free rate. The input value for the index normalizes the S&P 500 and sets the initial value equal to the strike price of $1,000. The only unobserved input measure for the option pricing model is volatility of index returns.

Because volatility measures the expected variability of returns over the remaining life of the option, the historical standard deviation of returns may not be appropriate. Instead to capture expectations of future volatility, we calculate the standard deviation of logarithmic returns from 10 quarters before purchase of the option to 10 quarters after initiation. The standard deviation computation then weights the returns around the option's purchase more heavily than returns at the beginning or end of the 20 quarter estimation period. In this way, volatility is conditioned upon past returns, weights more heavily immediate index returns, and also has a component that is forward looking. The exact computation for the volatility measure appears in an appendix.

After solving for the call option's fair market value, if the ELCDs residual investment amount ($1,000 less the bond price less the $25 transaction fee) is greater than or equal to the call premium, we purchase one option. Reinvestment of any money left over earns the risk free rate for the 5-year period. If the residual investment amount is less than the call price, we only purchase a fraction of the option.

At the option's expiration, we compare the (normalized) index value to the strike price of $1,000. If the intrinsic value is positive, this amount plus any interest earned from the risk free bond equals the return to the ELCD. If less than one option were purchased, the calculation multiplies the intrinsic value by the appropriate fraction. If, on the other hand, intrinsic value is 0, the ELCDs return equals only the interest paid on any investment in the risk free bond.

4. Historical results

Results for the historical analysis covering the period January 1981 through December 2004 appear in Table 1. In trying to answer whether equity-linked CDs have equity-like returns, we first consider the mean return for each 5-year investment vehicle. Had the IPCD been offered starting in 1981, it would have earned 8.27%, little different than the average return on the 5-year Treasury note. In contrast, the stock market as measured by the S&P 500 earned 14.49% for the same period, more than 6% higher than the equity-linked CD. This difference is mainly attributable to the averaging of quarterly prices in the IPCD that significantly lowers its mean return. If the investor put together a synthetic CD that uses the final index price instead of the average, her mean return would have been 13.28%, a value much closer to the market return for the period.

A comparison of mean returns does not tell the full story. For example, while the IPCD and 5-year Treasury note have nearly identical mean returns, the standard deviation of the IPCD is nearly 65% larger. Thus, from a risk and return perspective, the 5-year Treasury note dominates the IPCD during the sample period. Nevertheless, there were four 5-year periods where the IPCD had the highest return of all the investment strategies. In comparing the

Table 1
Annualized returns for five-year investments issued quarterly beginning first quarter 1981

Annualized returns	5-year treasury note	S&P 500 w/dividends	IPCD	Synthetic ELCD
Mean	0.08202	0.14493	0.08269	0.13275
Median	0.07510	0.15160	0.08065	0.13411
Standard deviation	0.02762	0.08056	0.04542	0.07341
Sample variance	0.00076	0.00649	0.00206	0.00539
Standard error	0.00317	0.00924	0.00521	0.00842
Coeff of variability	0.34	0.56	0.55	0.55
Skewness	1.02503	−0.60114	0.03031	−0.25154
Kurtosis	0.35953	0.00563	−0.36323	−0.43751
Range	0.11780	0.32207	0.18094	0.27248
Minimum	0.04400	−0.03758	0.00000	0.00000
Maximum	0.16180	0.28449	0.18094	0.27248
Number of periods with highest return	11	61	4	0
Percentage of periods with highest return	0.1447	0.8026	0.0526	0
Number of periods 0 return	0	0	6	8
Percentage of periods with 0 return	0.0000	0.0000	0.0789	0.1053
Number of periods negative return	0	9	0	0
Percentage of periods with negative return	0.0000	0.1184	0.0000	0.0000
Count (number of 5-year investments maturing through fourth quarter 2004)	76	76	76	76

Treasuries to the synthetic ELCD and S&P 500, more risk translates to higher expected returns, as we would expect.

Fig. 1 illustrates these relations in the performance plot of the four instruments. The synthetic ELCD and S&P 500 plot higher returns most of the time, yet the returns fluctuate more than the Treasury note and the IPCD. Fig. 1 also reveals the downside protection offered by the IPCD and ELCD. In the latter part of the sample period where 5-year returns on the S&P 500 are mostly negative, the returns to the IPCD and ELCD equal 0. This is because, at a minimum, both of the CDs return the investor's initial outlay.

To infer the betas of the IPCD and ELCD, we can compare their returns to the performance of the S&P 500 in Fig. 1. In the first part of the sample, the returns to the IPCD are significantly lower than the S&P 500, and when stock market returns turn negative, the returns to the IPCD equal 0. Taken as a whole, this implies that the ICPDs beta is considerably less than one. That the IPCD increases less than one-for-one with the S&P 500 is mainly the result of averaging index values and the 90% participation factor.

On the other hand, Fig. 1 shows that the returns to the ELCD are nearly equal to the S&P 500 returns when the stock market rises. This yields an ELCD beta only slightly less than 1. However, for the end of the sample period when stock market returns are negative, capital preservation implies an ELCD beta equal to 0. For the ELCD, more than the IPCD, there is a structural break for the instrument's beta in up and down markets. Thus, an ELCD has the nice feature that investors can participate in nearly all the upside gain when the market rises,

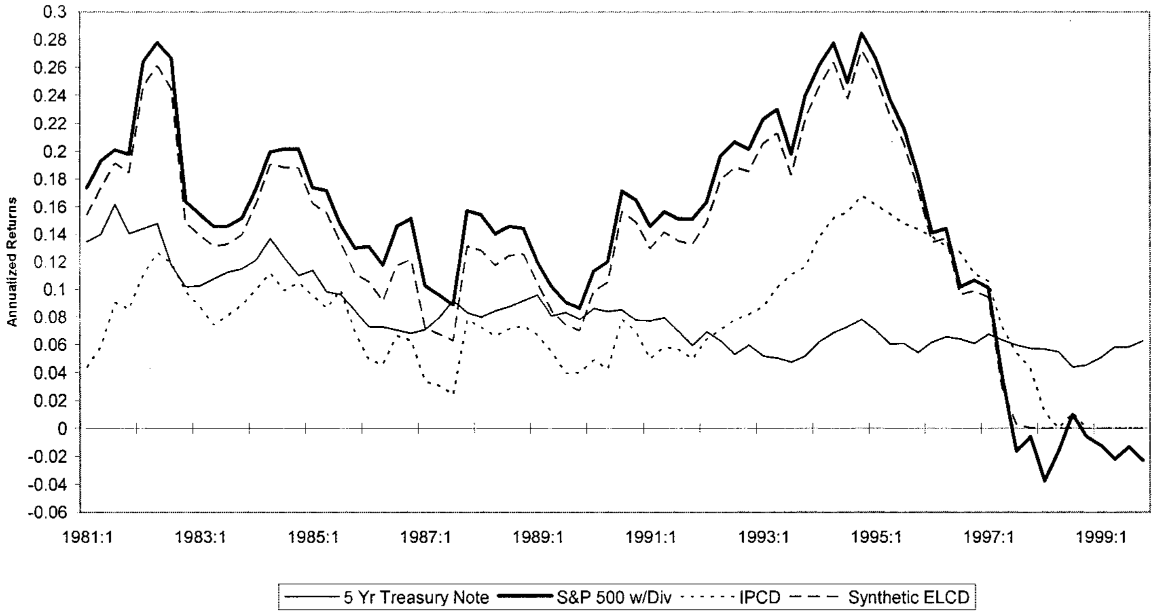

Fig. 1. 5-year investment issued quarterly 1981 through 1999 (maturing 1986–2004).

yet is insured from any downside market risk. This property is even more apparent in the next section that examines simulation results.

5. Simulation results

The historical analysis of 5-year investment periods uses overlapping quarters and results in serial correlation of returns. To correct for this and describe returns in an efficient market, we turn to Monte Carlo simulation. The simulation randomly selects 20 quarterly returns of the S&P 500 with replacement. We also randomly choose initial values of the S&P 500 dividend yield and 5-year T-note rate.

Table 2a illustrates sample data for one trial. Column 2 shows the random selection of 20 quarters from the historical data set and column 3 represents the corresponding calendar quarters. Column 4 contains the return on capital gains of the S&P 500 for each randomly drawn quarter and implies the (normalized) price index in Column 5. The quarterly returns of the S&P 500 including dividends appear in Column 6. Finally, Column 7 lists three input values. We select the first two, the dividend yield and risk free rate, by randomly drawing from the 96 quarters in our sample. The third input, volatility, is the sample standard deviation of log relative prices in Column 5 and is consistent with the assumption that the market's expected volatility is an unbiased measure of future volatility. We then substitute this last parameter into Merton's option pricing model.

The trial values in Table 2A lead to one realized return for each of the four strategies; the results appear in Table 2B. The return to the 5-year T-note equals the randomly drawn value of 5.97%. The quarterly returns in Column 6 along with Eqs. (1) and (2) yield an annualized

Table 2A
Sample of simulation data

QTR	Random qtr selection	QTR ID	Quarterly return of capital gains for QTR ID	Price index (derived)	Quarterly return with dividends for QTR ID	
1	2	3	4	5	6	7
0				1000		
1	76	2000:1	0.01996	1019.96	0.02281	
2	53	1994:2	−0.00336	1016.53	0.00384	Dividend yield 0.01588
3	22	1986:3	−0.07782	937.43	−0.06977	
4	16	1985:1	0.08024	1012.65	0.09207	
5	44	1992:1	−0.03213	980.11	−0.02474	Risk free rate 0.05970
6	14	1984:3	0.08435	1062.78	0.09663	
7	44	1992:1	−0.03213	1028.64	−0.02474	
8	35	1989:4	0.01217	1041.16	0.02008	Volatility 0.07393
9	54	1994:3	0.04151	1084.37	0.04878	
10	33	1989:2	0.07837	1169.36	0.08711	
11	8	1983:1	0.08760	1271.80	0.10000	
12	14	1984:3	0.08435	1379.07	0.09663	
13	22	1986:3	−0.07782	1271.75	−0.06977	
14	86	2002:3	−0.17634	1047.49	−0.17234	
15	47	1992:4	0.04287	1092.40	0.05028	
16	25	1987:2	0.04217	1138.46	0.04962	
17	66	1997:3	0.07020	1218.38	0.07453	
18	5	1982:2	−0.02099	1192.81	−0.00559	
19	34	1989:3	0.09803	1309.74	0.10641	
20	63	1996:4	0.07771	1411.51	0.08313	

return on the S&P 500 equal to 10.65%. The quarterly index values in Column 5 and Eqs. (3a) and (3b) imply an IPCD return of 3.61%. Finally, the synthetic ELCD uses the dividend, risk free rate and volatility measure to estimate the Merton call price and the risk free rate and Eq. (4) to calculate the discount bond price. These two values lead to the annualized return of 7.92% for the ELCD. We then repeat the Monte Carlo Simulation 10,000 times to generate return distributions for each of the four investment strategies.

Fig. 2 illustrates the basic differences between the simulated and historical mean returns. One result is that the Monte Carlo simulation yields a similar ranking of mean returns as the historical analysis. However, now the lowest mean return is the IPCD, while the S&P 500 again produces the highest average return. A second finding is that the historical means are uniformly higher than their simulation generated counterparts. The higher historical means can be attributed to the serial correlation of returns caused by overlapping periods.

Fig. 3 illustrates the complete return distributions of the four investment strategies, and

Table 2B
Example simulation run

	5-year treasury note	S&P 500	IPCD	Synthetic ELCD
Trial 1	0.05970	0.10652	0.03610	0.07917

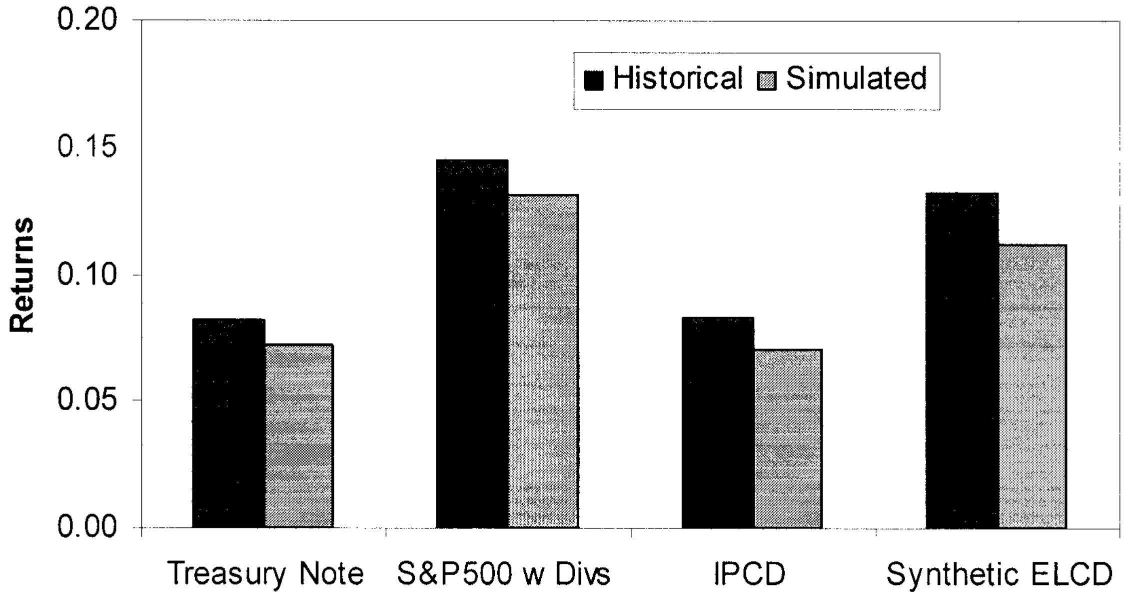

Fig. 2. Mean annualized returns on a 5-year investment.

summary statistics appear in Table 3. Beginning with the 5-year Treasury note, the mean is 7.2% with a standard deviation of 3.0%. The histogram shows a very peaked and tight distribution (Kurtosis = 3.41, range = 13.7%). The small standard deviation and narrow range confirm the low risk associated with this instrument. Of particular interest is that the low risk, 5-year Treasury note produces the highest return for almost 24% of the trials, a figure significantly higher than that found in the historical analysis.

The mean annualized return on the S&P 500 is 13% with a standard deviation of 8%. Moreover, the nearly perfect bell curve implies third and fourth moments close to the normal distribution's values of 0 for skewness and 3 for Kurtosis. Both the mean and standard deviation are the largest of all the instruments. This leads to the S&P 500 producing the highest return in nearly 74% of the 10,000 trials, although it also results in a negative return occurring approximately 5% of the time.

Investment in the IPCD yields a mean return of 7.1% with a standard deviation equal to 5.1%. The distribution is approximately normal but truncated on the low end at 0%. This lower bound occurs about 12% of the time, a proportion considerably higher than that found in the historical analysis. Furthermore, the IPCD produces the highest return of the four instruments less than 1% of the time, a percentage much lower than the historical figure. These characteristics taken as a whole argue that investors will find the IPCD a more attractive investment than the T-note only when interest rates are at an historic low, much as they have been since 2001.[2]

Finally, the synthetic ELCDs mean annualized return is 11.2% with a standard deviation approximately equal to 7.0%. Like the IPCD, the histogram shows a truncated lower end at 0%, but otherwise is approximately normal. The synthetic ELCD produces a zero return 2.0% of the time, but also outperforms the other three instruments nearly

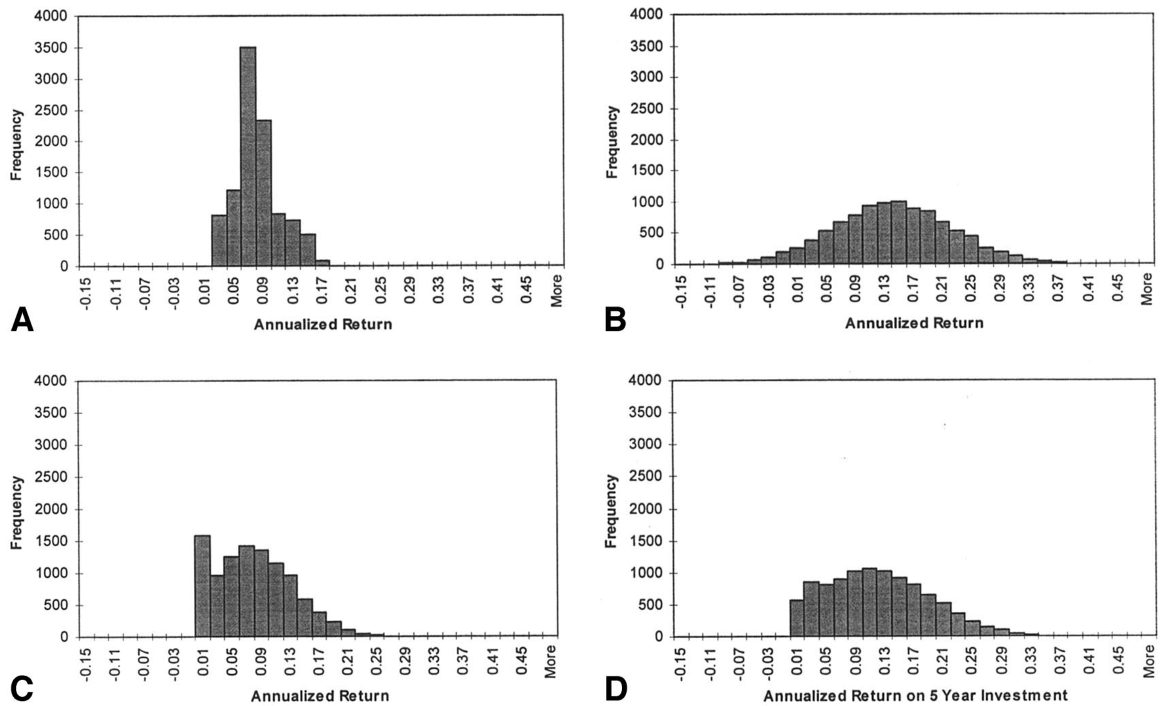

Fig. 3. (A) Simulated returns from the 5-year Treasury bill. (B) Simulated returns from the S&P 500 with dividends. (C) Simulated returns from the IPCD. (D) Simulated returns from the ELCD.

1% of the time. In the historical analysis, this never occurred. Thus, the synthetic ELCD combines attributes that might appeal to risk averse investors: limited downside risk with returns that are only 2% lower, on average, than returns to the market.

The synthetic ELCDs lower mean return than the S&P 500 is in part because of the fact that the investor can only purchase a fraction of the call option in several of the simulation trials. In nearly 20% of the Monte Carlo runs (1945 out of 10,000 trials), the difference between $1000 and the zero-coupon bond is less than the price of the at-the-money call on the S&P 500.[3] For these runs, the mean market participation factor is 85.33%, although the median is even higher at 89.53%. If we were to consider all 10,000 trial runs, the mean market participation factor is 97.15% so that, on average, an ELCD investor would participate in more than 97% of stock market capital gains.

Ultimately the individual's selection of an investment vehicle depends upon her risk preferences. At one extreme is investing in a Treasury security that has relatively low volatility and low expected return. For other individuals with higher risk tolerance, investing in the stock market is optimal. However, the simulation results show that a synthetic ELCD earns a return that, on average, is only 2% lower than the market, yet protects against losing the initial principal. Thus, for a fairly modest premium, the investor can shield herself from extreme downside risk. Moreover, the synthetic ELCD becomes more aggressive (defensive) as market returns increase (decrease), a property that benefits all investors no matter what their risk preferences.

Table 3
Simulation results: Annualized returns for five-year investments

Simulated annualized returns	5-year treasury note	S&P 500 w/dividends	IPCD	Synthetic ELCD
Mean	0.07199	0.13153	0.07069	0.11162
Median	0.06760	0.13096	0.06693	0.10672
Standard deviation	0.02970	0.08091	0.05127	0.06978
Variance	0.00088	0.00655	0.00263	0.00487
Mean standard error	0.00030	0.00081	0.00051	0.00070
Coeff. of variability	0.41	0.62	0.73	0.63
Skewness	0.77	0.01	0.45	0.44
Kurtosis	3.41	2.98	2.62	2.71
Range	0.13720	0.59271	0.26915	0.40683
Minimum	0.02460	−0.15305	0.00000	0.00000
Maximum	0.16180	0.43966	0.26915	0.40683
Number of periods with highest return	2396	7391	73	140
Percentage of periods with highest return	0.2396	0.7391	.0073	.0140
Number of periods 0 return	0	0	1206	199
Percentage of periods with 0 return	0	0	0.1206	0.0199
Number of periods negative return	0	509	0	0
Percentage of periods with negative return	0	0.0509	0	0
Trials (number of 5-year investments)	10,000	10,000	10,000	10,000

6. Conclusions

Do equity-linked CDs have equity-like returns? The simple answer is no. In fact, the Index Powered CD and similar retail products have a mean expected return and standard deviation that differ little from the 5-year Treasury note. In an unconditional probability setting, it appears that few investors would choose the IPCD over the T-note.

However, a more relevant comparison is between the IPCD and the current 5-year T-note yield that is known with certainty. Given the recent low interest rate environment, investors may prefer the IPCD whose expected return is greater than the return to investing in the T-note. Nevertheless, there is the possibility that the IPCD will earn 0 over the next five years. Moreover, the averaging of quarterly prices and 90% participation factor imply that the IPCDs expected return is significantly below the market's mean return. Thus, investors should not expect the IPCD would earn market-like returns; instead, the instrument performs as if it were a low beta asset.

Perhaps a more attractive investment alternative is the synthetic ELCD. A portfolio of a zero-coupon bond and call option on a stock index results in a return distribution that guarantees principal and has the potential of earning returns only slightly less than the market. This implies the nice property that the synthetic ELCD has a 0 beta in a down stock market and a beta close to 1 when there is a healthy, positive market return.

The final question then becomes why would anyone invest in retail products like the IPCD given the alternative of a synthetic ELCD? One possible answer is that investors cannot easily estimate the return distributions of the different 5-year investment strategies. In the absence of detailed analysis, investors interpret the marketing literature that stresses the safe return of principal with the opportunity to participate in positive market returns as a win-win opportunity. A second possibility is that investors have a good notion of ex ante return distributions, but value the convenience of a prepackaged zero-coupon bond and stock index call option. If this is the case, the difference between the expected returns of the IPCD and synthetic ELCD represents the value of prepackaging. A third possibility is that while they would prefer the synthetic ELCD to the prepackaged IPCD, they are unable to purchase a 5-year stock index call option. In fact, it is possible to purchase a flex option with unique expiration terms on the Chicago Board Options Exchange but only for large notional values. If the individual were trying to invest in the synthetic ELCD for smaller amounts, she would have to rollover a position in Long-term Equity AnticiPation Securities (LEAPS), options with an initial expiration of three years. Under typical market conditions this might increase the cost of the option strategy by roughly 50 basis points, on average.

From the above analysis, it is clear that for retail products like the IPCD to be a commercial success, they must remain competitive with alternative investment strategies. That means as yields on the 5-year T-note increase, the terms of the CD must also become more generous. Moreover, as investors and financial markets become more sophisticated, the retail equity-linked CDs must also compete with attractive return distributions implied by a synthetic ELCD strategy. As competition increases, the value of prepackaging should then approach the transaction costs of investing in the synthetic ECLD.

Notes

1. Chen and Kensinger (1990) also focus on the ELCD issuer's risk exposure and discuss possible dynamic hedging strategies. Milevsky and Kim (1997) present the Canadian experience with equity-linked time deposits, while popular press articles that describe ELCDs include Britt (2003), MacDonald (1992), Newkirk (2001), O'Connell (1994), and Reosti (2001).
2. It is entirely possible that as the yield curve shifts up, terms of the IPCD will also become more attractive. For example, higher interest rates make the implied zero-coupon bond cheaper so that the IPCD might offer a market participation factor equal to 100%.
3. In 199 of the 1945 cases, the stock market declines over the 5-year period so that a market participation factor less than 100% has no effect on the ELCDs return which equals 0.

Acknowledgments

The authors would like to thank an anonymous reviewer and the editor, Conrad Ciccotello, for their comments and suggestions that substantially improved the manuscript's content and exposition. Any remaining errors are the sole responsibility of the authors.

Appendix

The volatility measure used in any option pricing model should represent the expected variability of returns over the remaining life of the option. One method of estimating volatility is to use variance of historical returns; however, this assumes that future volatility replicates the past. To incorporate both recent market experience and the forward looking nature of expected volatility, our methodology uses both past and future logarithmic returns. Specifically, we compute the variance of the quarterly returns for 20 quarters centered on the quarter of interest with the following graduated weights:

Quarter	q-9	q-8	q-7	q-6	q-5	q-4	q-3	q-2	q-1	q
weight	1	2	3	4	5	6	7	8	9	10

Quarter	q+1	q+2	q+3	q+4	q+5	q+6	q+7	q+8	q+9	q+10
weight	10	9	8	7	6	5	4	3	2	1

The variance for quarterly returns is then

$$Var(r_q) = \frac{1}{n-1}\left[\sum_{q-9}^{q+10} w_q r_q{}^2 - \frac{\left(\sum_{q-9}^{q+10} w_q r_q\right)^2}{n}\right] \quad (5)$$

where r_q is the logarithmic quarterly return of the qth quarter, w_q is the weight of $r_{q,}$ and $n = \sum_{q-9}^{q+10} w_q = 110$. The square root of this variance yields the standard deviation of quarterly returns. To annualize this number, we then multiply the standard deviation by the square root of four.

This method requires additional historical quarterly data from the S&P 500 to compute volatility; for example, volatility for first quarter 1981 requires knowledge of quarterly returns for nine quarters before and 10 quarters subsequent to Q1 1981. As well, the volatility for the final quarter requires quarterly data from 10 quarters subsequent to the period. Thus the data set for computing volatility for Q1 1981 through Q4 1999 begins with Q4 1978 and ends with Q4 2004.

References

Abken, P. (1989). *A survey and analysis of index-linked certificates of deposit.* Working Paper 89-1, Federal Reserve Bank of Atlanta.

Baubonis, C., Gastineau, G., & Purcell, D. (1993). The banker's guide to equity-linked certificates of deposit. *The Journal of Derivatives*, *1*, 87–95.

Britt, N. (2003). Another option. *Forbes*, *172*, 126–128.

Chen, A., & Kensinger, K. (1990). An analysis of market-index certificates of deposit. *Journal of Financial Services Research*, *4*, 93–110.

FDIC. (2004). *Quarterly banking profile, fourth quarter 2004.* Federal Deposit Insurance Corporation, Washington, D.C., pp.1–20.

MacDonald, E. (1992). Stock-linked CDs give fat rate or heartburn. *Money*, *21*, 16–17.

Merton, R. (1973). Theory of rational option pricing. *Bell Journal of Economics and Management Science*, *4*, 141–183.

Milevsky, M., & Kim, S. (1997). The optimal choice of index-linked GICs: some Canadian evidence. *Financial Services Review*, *6*, 271–284.

Newkirk, K. (2001). A sure thing, variable-rate CDs can boost core deposits and customers' return. *Independent Banker*, 65–66.

O'Connell, V. (1994). Stock CDs don't deliver market gains. *Money*, *23*, 40–42.

Reosti, J. (2001). CD for small banks tracks the S&P 500. *American Banker*, *166*, 5. AQ1: Please check sentence for clarity.