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Embedded options in enhanced certificates of deposit

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Abstract

Deregulation and competition have led to the introduction of many new esoteric investment products in the financial service industry. One such product is the enhanced certificate of deposit, which contains embedded interest rate options. These securities are commonly known as flex certificates of deposit. We find that these products are currently being priced in a peculiar manner. A discussion of the logical breakdown of options embedded in the flex certificate of deposit is given. We also consider why banks are willing to give away valuable interest rate options.

Jel classification: G2

*Keywords:*Certificates of deposit; Flex CDs; Flexible CDs; Enhanced CDs; Embedded options

1. Introduction

The purpose of this article is to provide a general framework for understanding enhanced certificates of deposits (CDs) that contain embedded options and a mechanism for comparing enhanced CDs, which contain these embedded options, with traditional CDs, which contain no options. This approach will be useful to both banks and depositors. It enables bankers to better price the products they offer and allows them to understand the risks associated with these products. This approach aids depositors in comparing different CD products offered by these institutions. The research here suggests that the current yields on CDs containing these embedded options do not accurately reflect the value of the investor's options.

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Retail banking has undergone dramatic changes in recent years. Due to deregulation and increased competition, banks must aggressively compete to maintain market share and profits. This competition among banks has led to the introduction of many new deposit instruments. In an effort to increase deposits as well as lower the cost of funds, new exotic products are being offered today.

Enhanced CDs are now being offered with features such as penalty-free withdrawals, unlimited deposits, and the ability to adjust the "fixed" interest rate to a higher rate at any time during the life of the CD. There are variable rate CDs offered with floors, CDs with payouts tied to stock indexes, and even CDs whose payout depends on the winners of sporting events. One specific example of an enhanced CD is the flex CD offered by a regional bank located in the southeast, which will be referred to as Bank A[1] throughout this paper. The flex CD is offered with 13- and 21-month maturities and contains the following three options: the option to make deposits up to $99,000, one penalty-free withdrawal of any amount, and a one-time rate adjustment option. A survey of banks located in the Birmingham Alabama area, shown in Table 1, revealed that other banks in that area offer products similar to the flex CD of Bank A. Outside the Birmingham area, other banking institutions (referred to as Banks 1, 2, 3, and 4) are also offering similar products. Bank 1 offers a 24-month flex CD that permits additional deposits to be made to the certificate in an amount equal to the original deposit, one penalty-free withdrawal, and one rate adjustment option. Bank 2 offers a 12-and 24-month "Triple Option" CD that allows deposits up to the original face value of the CD, one penalty-free withdrawal, and a one-time rate adjustment option. Bank 3 offers a 7- and 12-month "Flex Plus Certificate" with two embedded options: unlimited deposits and one penalty-free withdrawal. Bank 4 offers its "Flex Savers" CD with both 24- and 36-month maturities that allow the depositor to make deposits up to 25% of the original deposit amount, withdrawals of 25% of the original deposit amount, and a one-time rate adjustment option.

Previous research has been devoted to embedded demand deposit options. Hannan and Berger (1991) found that four factors influence an investor's early withdrawal decision: the reinvestment incentive, the size of the face value of the deposit, whether or not the CD is pledged collateral, and idiosyncratic liquidity needs of the investor. Gilkeson, Porter, and Smith (2000) developed the withdrawal option pricing hypothesis, which suggests yield spreads between 5-year retail CDs with a par value greater than $90,000 and similar treasuries reflect embedded withdrawal options. Brooks (1996) provided a framework for comparing CD products containing embedded derivatives by demonstrating how to compute the annual percentage yield (APY) and effective annual rate (EAR) for CDs with embedded withdrawal options.

Certificates of deposit provide banking institutions with a significant source of funds. While demand for deposit products has significantly declined since the 1980s, evidence suggests that deposit products are becoming increasingly popular with individual investors. The FDIC's Second Quarter 2002 Quarterly Banking Profile (FDIC, 2002) reported that, among FDIC-insured institutions, deposits were up 4.6% from second quarter 2001 to second quarter 2002. In addition, the Profile reported a 14.1% increase from second quarter 1999 to second quarter 2001 (FDIC, 2001). A survey conducted in the southeastern United States revealed that CDs represented an average of 45% of the total assets of small banks. Thus, in

Table 1
Survey of banks located in the Birmingham, Alabama area

Bank	Product	Min	Maturity	Withdrawal Option	Deposit Option	Rate Adjustment Option	Other
Alamerica Bank	Traditional CDs only						
Aliant Bank	Traditional CDs only						
Amsouth Bank	Flex CD	$10,000	7 month 17 month 37 month	The option to withdraw any amount once, penalty-free.	The option to add deposits up to $90,000, in increments of $100, at the fixed rate.	Option to adjust to the new market rate of the same term CD once during the life of the CD.	
BancorpSouth	Flex CD	$500	11 month 21 month		The option to add unlimited deposits, in increments of $1000, at the fixed rate. Available only if customer also has a checking account.	Option to adjust to the new market rate of the same term CD twice during the life of the CD. Available only if customer has a checking account.	
Bank of Alabama	Traditional CDs only						
Bank of Tuscaloosa	Bump- Up CD	$1,000	8 month 13 month 21 month			Option to adjust to the new market rate of the same term CD once within 90 days of opening the account.	
Central State Bank	Special CD	$500	10 month	The option to withdraw up to $999,999 one time, penalty-free.			
Citizens Federal Bank	Traditional CDs only						
Colonial Bank	Option CD	$1,000	12 month 18 month 24 month		The option to add deposits up to $99,000, in increments of $500, at the fixed rate.	Option to adjust to the new market rate of the same term CD once during the life of the CD.	
Compass Bank	Traditional CDs only						
First Commercial Bank	Traditional CD	$1,000	All			Option to adjust to the new market rate of the same term CD once during the life of the CD.	
First Financial Bank	Option CD	$1,000	60 month			Option to adjust to the new market rate of the same term CD once during the life of the CD.	

Continued

Table 1 *Continued*

Bank	Product	Min	Maturity	Withdrawal Option	Deposit Option	Rate Adjustment Option	Other
First National of Jasper	Option CD	$1,000	14 month 25 month			Option to adjust to the new market rate of the same term CD once during the life of the CD.	
First United Security Bank	Flex CD	$1,000	13 month 21 month	The option to withdraw any amount once, penalty-free.	The option to add deposits up to $99,000, in increments of $100, at the fixed rate.	Option to adjust to the new market rate of the same term CD once during the life of the CD.	
Heritage Bank	Option CD	$1,000	14 month 25 month			Option to adjust to the new market rate of the same term CD once during the life of the CD.	
National Bank of Commerce	Traditional CDs only						
New South Federal Savings	S&P Linked CD	$5,000					Yield determined by appreciation of S&P 500.
Peoples Bank	Bump- Up CD	$10,000	26 month			Option to adjust to the new market rate of the same term CD once during the life of the CD.	
Peoples Bank and Trust	Traditional CDs only						
Regions Bank	Option CD	$1,000	All	One time penalty-free withdrawal during a 10-day window, half way to the stated maturity.			
Southtrust Bank	Traditional CDs only						
State Farm Bank	Market Rate CD	$500	60 month				Yield determined by appreciation of S&P 500.
The Bank	Traditional CDs only						
Union State Bank	Traditional CDs only						

order to remain competitive, banks need methods to aid them in setting rates and providing insight into the potential risks associated with these deposit products. For example, in the case of the flex CD, banks need to understand the likelihood and related costs of depositors exercising any of the embedded options. Likewise, individual investors need these same methods to compare the wide range of products offered by banks. Knowledge of the potential value of these exotic products will enhance investor decision-making.

In this article, we provide a framework for understanding the options embedded in the flex CDs offered by Bank A. Through this procedure, it will be shown that these products are priced in a very unusual manner. We begin with a general discussion of the bank production function and a brief comparison of the terms of the flex CD. Next, we present a logical breakdown of the embedded options in the product and the implications they have on pricing the flex CD. In this discussion an explanation will be offered explaining why banks may price the products in the current manner. Finally, we will conclude the paper with a discussion focusing on the implications and opportunities this pricing procedure provides to the individual investor.

2. The bank production function

Studies involving the production approach began with the works of Benston (1965) and Bell and Murphy (1968) which explain banking activities as the production of services to depositors and borrowers. By facilitating the flow of funds from surplus units to deficit units, banking institutions provide a crucial function in financial markets. In facilitating this flow of funds, banks invest in loans and securities using the funds obtained from deposit accounts and borrowed funds. Profits are generated by repackaging these funds into various products attractive to lenders and retail investors, thus generating a spread between the average cost of funds and the return earned on the bank's loan portfolio. This task is associated with interest rate risk, liquidity risk, market risk, and credit risk. Therefore, banks must set rates on deposits and loans while considering these risks and other costs associated with running a bank. Another consideration that must be made, particularly when determining the rate to be offered on the flex CD, is the retail customer's cost of convenience. Convenience can play a major role in the inefficient exercise of the embedded options. For example, it might be the case that a bank can knowingly offer an above average rate on a flex CD if they are reasonably confident that a large percentage of their customers will not exercise the embedded options due to inconvenience. Inconveniences could include such factors as time and effort of keeping up with current market rates and the physical effort required to go to the bank and exercise the options.

Much research has been devoted to the pricing of CDs, with most of the attention being placed on large-denomination CDs (James, 1987; Hannan & Hanweck, 1988; Ewing, Payne, & Forbes, 1998). A second group of studies has focused on small/retail CDs (Berger & Hannan, 1989; Calem & Carlino, 1991; Cooperman, Lee, & Lesage, 1991). Hempel and Simonson (1999) examined the funding characteristics of commercial banks and discovered that bank size played a role in the pricing of time deposits. Jordan (2000) studied failing banks in the New England area and found that banks facing a shortfall in funding were

Table 2
Terms of 13-month flex and traditional CD

	Terms of flex CD 13:
Date:	April 19, 2002
Instrument:	FLEX CD 13
Term:	13 Month
Rate information:	The interest rate of the account is 2.45% with an annual percentage yield of **2.47%.** Interest begins to accrue no later than the business day we receive credit for the deposit.
Rate change option:	Customer may change the rate once during the term.
Early withdrawal option:	Customer may make one penalty free withdrawal of any amount from the account. After the one free withdrawal the penalty is 3 months interest in the amount withdrawn.
Deposit option:	Customer may make incremental deposits of $100.00 not to exceed $99,000 throughout the term of the account.
	Terms of traditional CD 13:
Date:	April 19, 2002
Instrument:	TRADITIONAL CD 13
Term:	13 Month
Rate Information:	The interest rate of the account is 2.61% with an annual percentage yield of **2.63%.** Interest begins to accrue no later than the business day we receive credit for the deposit.

typically more aggressive in their pricing. Gup and Nam (2003) examine variations in CD yields and find strong evidence that asset size, the cost of funding earning assets, and the ratio of noninterest-bearing deposits to total deposits were significantly related to these pricing differences.

These studies suggest that there are many factors that banks must consider when they set prices on retail deposits. Therefore, a culmination of all these factors should be considered when determining if rates being offered are appropriate for a given bank. This paper focuses solely on the options embedded in retail deposits and offers insight into the theoretical yields that should be offered on such products. Thus, the main contribution of this paper is that it provides a mechanism by which individual investors can assess the relative value of these retail products.

3. The traditional CD and the flex CD

Terms of the 13-month flex CD and the 13-month traditional CD are provided (Table 2) for comparison between the two products. The motivation for this paper is derived from actual observations of flex CD rates being paid by banking institutions. If the embedded options of the flex CD have value, then it should be the case that the annual percentage yields (APYs) on the 21-month flex product (Table 3) should be lower than the APYs offered on the 13-month flex product (Table 2), since longer-term options have greater value than the shorter-term options. Valuing the liquidity given up by the investor for longer commitments of funds, banks typically offer higher yields for longer maturity products. However, with the

Table 3
Terms of 21-month flex and traditional CD

	Terms of flex CD 21:
Date:	April 19, 2002
Instrument:	FLEX CD 21
Term:	21 Month
Rate information:	The interest rate of the account is 2.75% with an annual percentage yield of **2.78%.** Interest begins to accrue no later than the business day we receive credit for the deposit.
Rate change option:	Customer may change the rate once during the term.
Early withdrawal option:	Customer may make one penalty free withdrawal of any amount from the account. After the one free withdrawal the penalty is 3 months interest in the amount withdrawn.
Deposit option:	Customer may make incremental deposits of $100.00 not to exceed $99,000 throughout the term of the account.
	Terms of traditional CD 21:
Date:	April 19, 2002
Instrument:	TRADITIONAL CD 21
Term:	21 Month
Rate Information:	The interest rate of the account is 3.22% with an annual percentage yield of **3.06%.** Interest begins to accrue no later than the business day we receive credit for the deposit.

flex CD, while there is a longer stated maturity, there is no loss of liquidity on the part of the investor since they receive one penalty-free withdrawal. Hence, there should be no compensation for longer-term investments unless the bank believes depositors will not exercise the embedded options. In fact, these investments should be discounted because all optionality is given to the investor. The investor decides the effective maturity of the CD, independent of the stated maturity. Thus, the APY of the 21-month flex CD should never be higher than the APY of the 13-month flex CD since options with greater value are given to the depositor in this case.

Since general option pricing theory suggests that options of longer-maturity should have greater value than those of shorter maturity, it is puzzling that the longer-maturity flex CDs pay a higher yield than those of shorter maturity. Furthermore, it is puzzling that the flex CDs pay a higher yield than the money market rate. By arbitrage, the flex CD should never earn a higher rate than that being earned on a money market account, nor should it be the case that the longer-maturity product pays a higher yield than the shorter maturity. Since the pricing pattern violates basic arbitrage conditions, a model is not necessary to show that the embedded options of the product are not being priced at their theoretical values. Interestingly, this pricing pattern has persisted over several years (Fig. 1) and across the banking industry.

One way of viewing this pricing puzzle is in the context of asymmetric information-based pricing models in the market microstructure literature. Beginning with Bagehot (1971), theory emerged that explained market prices based upon information. This theory was later formalized beginning with Copeland and Galia (1983). In the flex CD market, it is reasonable to assume that some fraction of investors are informed and some fraction uninformed, where in this context uninformed would be defined as having a cost of convenience large enough

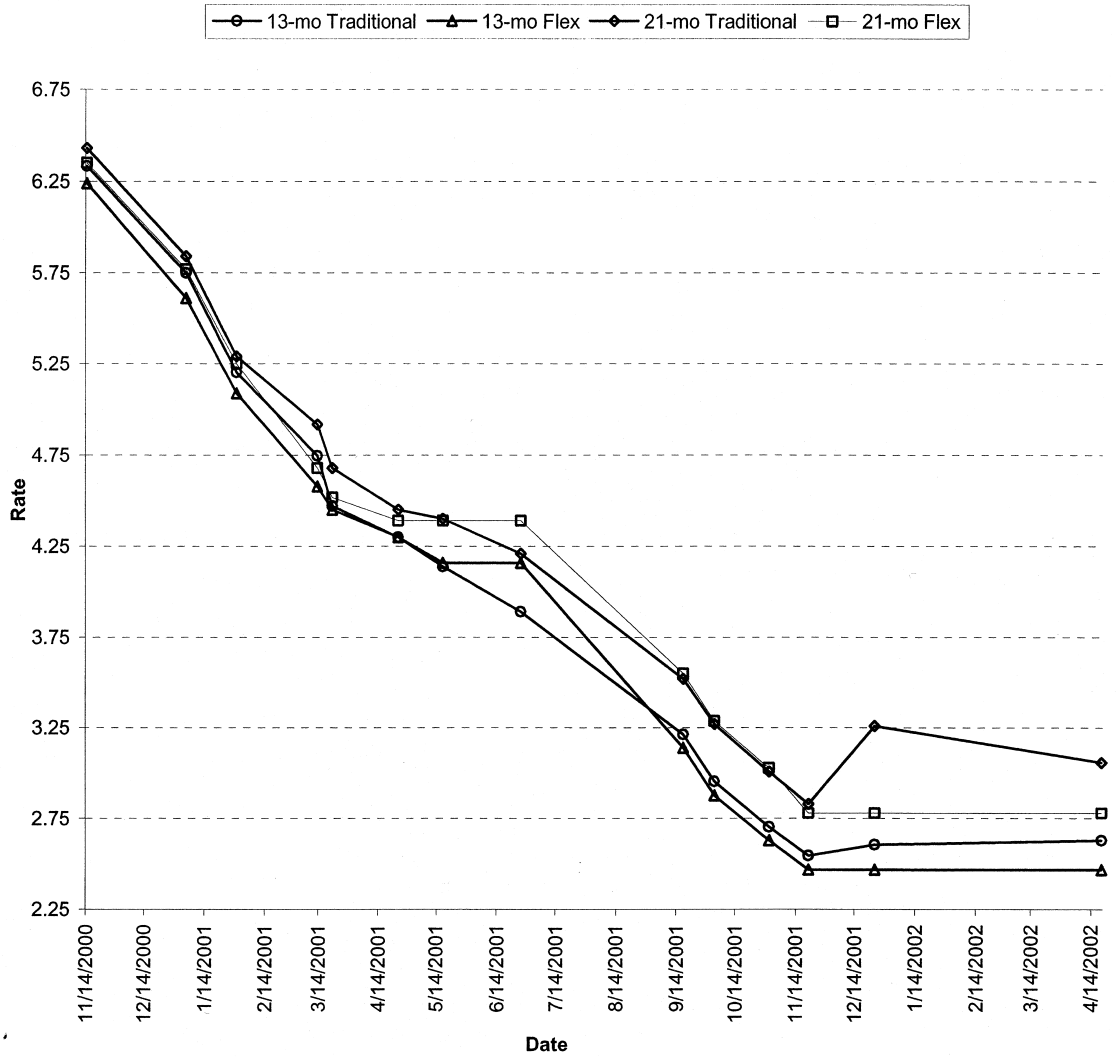

Fig. 1. This chart reports historical interest rate quotes from a southeast regional bank observed from November 2000 to April 2002. Included in the graph are quotes for the 13- and 21-month flex CD product as well as the 13- and 21-month traditional CD product. The table illustrates the fact that the CDs are being priced incorrectly, since the longer-maturity CDs with the longer-maturity options offer higher yields than the shorter-maturity CDs with the shorter-maturity options.

so that it is undesirable to monitor market rates or take time to exercise the embedded options. Banks know that some portion of investors have better information than others and furthermore, banks realize that they lose when trading with these investors. To be profitable, banks must offset these losses with uninformed investors. The pricing puzzle can best be explained in that a large portion of CD investors have a significantly large convenience cost that they remain uninformed, thus banks can offer rates above theoretical levels and still

profit since the average investor will remain uninformed and choose not to exercise the embedded options.

Thus, for the informed investor (which we will call the market astute investor) these deposit products offer more relative value than other traditional products, as their pricing assumes inefficient exercise of the options embedded within the product. Specifically, for investors whose cost of convenience are sufficiently low and have available funds, these flex products have value that is not currently being pricing into the product.

4. Enhanced CD pricing hypothesis

In this section, a logical breakdown of the embedded options of the flex CD is provided. From the term sheets illustrated in Tables 2 and 3, the only difference in the two products is the embedded options of the flex CD and the difference in the APY of the two products. An investor purchasing a flex CD is essentially purchasing a combination of four investments: a traditional CD with the same maturity and three interest rate options. Hence, the flex CD is simply a traditional CD with three added features: 1) the option to add deposits at the fixed rate up to $99,000; 2) the option to withdraw any amount once, penalty-free; 3) the option to adjust the fixed rate to the current market CD rate.

Assuming equal rates, a rational investor would prefer the flex CD to the traditional CD, since owning the flex CD is equivalent to owning a traditional CD plus a set of options. The investor should be willing to receive a lower APY for the flex CD than they would require of a traditional CD with the same maturity, implying that in equilibrium, flex CD yields will be lower than traditional CD yields.

Likewise, it is more costly for the bank to provide these embedded options to the investor; therefore, they should offer a lower yield to an investor supplying funds through this product, because all optionality is provided to the investor. Taking these options into account, any factor that leads to an increase in the value of the embedded options should also lead to a decrease in the yield on the flex CDs relative to the traditional CDs.

Previously, we have argued that the APY of the flex CD should be lower than the APY of the traditional CD. The magnitude of the difference should be the basis point value of the options embedded in the product. Therefore, assuming that the traditional CDs are correctly priced, one should be able to find the total value of the options in basis points and subtract it from the APY of the traditional CD to arrive at the value of the flex CD. This value can then be compared to the value assigned to the options by the bank, which is the difference in the traditional CD and the flex CD offered by the bank.

4.1. The option to withdraw any amount once, penalty-free

The option to withdraw any amount should be viewed as a put option, since it gives the depositor the right to sell the CD back to the bank. The depositor should cash in or sell the CD back to the issuer whenever interest rates increase. We will assume that all investors are rational and have no specific investment horizon. Thus, when exercising this withdrawal feature, they withdraw the entire amount in the account, reinvesting in the same product with

the same maturity. It might appear that this assumption indicates that investors do not care about the final maturity of the investment; however, since they are assumed to reinvest in a CD with the same embedded options, they are receiving a withdrawal option with the new investment. Therefore, they can effectively make the maturity as short as they desire. Since this option to put back a fixed-rate CD is equivalent to holding a floating-rate CD with a guaranteed floor equal to the fixed yield on the CD, the value of this option should be valued as a put option with a strike price equal to the stated flex CD rate (for example, 2.47% for the FLEX CD 13 in Table 2). The financial value associated with the withdrawal option derives from the investor's ability to exercise the option and reinvest in a new security with equal maturity at a higher fixed rate. The premium paid for the option, which consequently is the market price of the option, is the reduction in the yield that the bank demands for selling the option.

The option should be valued as an American-style option since it can be exercised any time prior to maturity. Furthermore, it should be noted that it not only can be exercised any time prior to maturity, but it should be exercised anytime the option is at the money or in the money, and that any rational investor would do so. Everything else held constant, the value of the option increases as the stated maturity of the option is lengthened. With these particular options, the maturity of the option is always equal to the maturity of the CD; thus, the maturity of the option will be lengthened as the maturity of the CD is lengthened. All rational investors will exercise the option as soon as it is in the money or even at the money, since exercising the option and purchasing the same product allows the investor to receive a CD with a higher annual percentage yield (or at least the same APY if at the money) plus an option with a longer maturity than the one being exercised. The investor will not only receive the longer maturity put option, as described here, but will also receive longer maturity on all the other options inherent in the flex CD.

It is then necessary to value the withdrawal option as an American-style put option that will be exercised as soon as the option is in the money or at the money. The strike price is the flex CD rate (for example, 2.47% for the FLEX CD 13 in Table 2). The premium paid for the option, and consequently the market price of the option, is the reduction in the yield on the CD that the bank demands for providing the option. Thus, the value of the withdrawal option is

$$= \text{Max}\,[0, (\text{Flex CD rate} - \text{market rate})] \tag{1}$$

where the market rate is the new rate quoted for the flex CD.

4.2. The option to adjust the fixed rate to the current market rate

The rate adjustment option allows the investor to adjust the stated fixed rate of the CD to the new market rate, where the market rate is the rate offered at that point in time on the same product with the same original maturity as the current CD. This option will only be exercised when rates have risen relative to the stated fixed rate. However, following the same logic discussed above, which dealt with the value of the longer maturity options, it should be noted that this option should never be exercised, and thus contains no value to a rational investor since the investor also has the withdrawal option mentioned above. Because the investor can

withdraw the entire amount and enter into a new CD with the new market rate and a longer time to maturity, the rational investor will always exercise this option instead of the rate adjustment option. Therefore, in this valuation approach we will assign no value to this rate adjustment option.

4.3. The option to add deposits at the fixed CD rate

The option to add to the original investment should be viewed as a call option, since it gives the depositor the right to purchase more of the investment at the contracted rate of the CD. The contracted interest rate on the CD represents the option's strike price. Thus, this option will be exercised as rates fall below the stated rate of the flex CD (for example, 2.47% for the FLEX CD 13 in Table 2). There is also another option embedded within this deposit feature that has not previously been noted. Since the investor has the right to deposit an unlimited amount within a given range, a quantity option is involved. In essence, an investor can purchase the flex CD for the minimal deposit amount of $1000 and add $99,000 (exercise 99 deposit options) to the account at the fixed rate. As rates decline, this option has considerable value to the investor.

The quantity option is actually a quantity option on the deposit option itself. As a result, this quantity option cannot be exercised if the deposit option is not exercised and furthermore, must be exercised when the deposit option is exercised. Hence, they will also have the same strike rate. These two options should be valued together to determine the total value of the deposit feature of the CD.

The total deposit option is an American-style option and should be valued as such; however, there is no closed form valuation method, since it is dependent upon the individual investor. For this reason, it is not known with certainty when or by what amount the investor will exercise, as this will depend upon the availability of funds to the investor. Therefore, it is necessary that the "market price" be adjusted to account for some "cost of funds" the investor will incur at exercise, which for our purposes here is called the "spread adjustment." The spread adjustment is a function of both the borrowing cost and the opportunity cost of the investor since these are the two sources from which the investor can gather funds. The borrowing cost is the rate at which the investor can borrow additional funds, and the opportunity cost the rate the investor is currently receiving and thus will have to forego to add funds to the flex CD. It is unlikely that a CD investor would consider borrowing funds to add to the principle of the CD; hence, it would be reasonable to assume that most of the additional deposits would come from foregoing other investment opportunities. The basis point value of the deposit option, including the quantity option and spread adjustment, is as follows:

$$= [0, \{(\text{Market rate} - \text{spread adj.}) - \text{flex rate}\}] \times \text{quantity exercised} \quad (2)$$

The strike rate is the stated flex CD rate (for example, 2.47% for the FLEX CD 13 in Table 2). The premium paid for the option and consequently, the market price of the option, is the reduction in the yield on the CD that the bank demands for providing the investor with the option.

Fig. 2 provides the actual historical rates at which the traditional and flex products were

	Section 1				Section 2		Section 3	
	Traditional CD APY's		Flex CD APY's:		Option Value Assigned by Bank		S-T Vol	L-T Vol
Date:	13-Month	21-Month	13-Month	21-Month	13-Month	21-Month		
11/14/2000	6.33	6.43	6.24	6.35	0.09	0.08		
1/4/2001	5.75	5.84	5.61	5.77	0.14	0.07		
1/30/2001	5.20	5.29	5.09	5.25	0.11	0.04	17.9	18
3/13/2001	4.75	4.92	4.58	4.68	0.17	0.24	6.7	13
3/21/2001	4.47	4.68	4.45	4.52	0.02	0.16	22.9	17
4/24/2001	4.30	4.45	4.30	4.39	0.00	0.06	43.4	29
5/17/2001	4.14	4.40	4.16	4.39	-0.02	0.01	24.3	29
6/26/2001	3.89	4.21	4.16	4.39	-0.27	-0.18	11.7	15
9/17/2001	3.22	3.52	3.14	3.55	0.07	-0.03	37.6	33
10/3/2001	2.96	3.27	2.88	3.29	0.08	0.05	30.0	17
10/31/2001	2.71	3.01	2.63	3.03	0.08	-0.02	22.6	19
11/20/2001	2.55	2.83	2.47	2.78	0.08	0.05	32.1	43
12/24/2001	2.61	3.26	2.47	2.78	0.14	0.48	27.2	30
4/19/2002	2.63	3.06	2.47	2.78	0.16	0.28	16.1	7

Fig. 2. This chart reports historical interest rate quotes from a southeast regional bank observed from November 2000 to April 2002. Included in the chart are quotes for the 13- and 21-month flex CD Product as well as the 13- and 21-month traditional CD Product (Section 1). The table illustrates the fact that the CDs are being priced in a manner that violates basic arbitrage conditions, since the longer-maturity CDs with the longer-maturity options offer higher yields than the shorter-maturity CDs with the shorter-maturity options. Also included in the chart is the value assigned to the options by the bank (Section 2), and historical short-term and long-term volatility (Section 3).

offered for both the long and short-term maturities (Section 1), along with the value assigned to the options by the bank (Section 2). As Fig. 2 illustrates for the period November 2000 to April 2002, the bank priced these investment products in a very unusual manner. In each case, the 21-month flex CD yield is greater than the 13-month flex CD yield; furthermore, in every period, the flex CD rate exceeds the money market rate. Another interesting point

is that the pricing policy does not appear to change as interest rate volatility changes (Section 3).

What should be addressed is the question of why banks price flex CDs in this manner. Since this pricing pattern has been persistent over time, it is reasonable to assume that banks offering the flex CD believe the average investor is depositing all funds up front and intends to keep the money invested for the full term. Thus, the pricing puzzle is primarily due to the fact that the bank's pricing assumes inefficient exercise of the embedded options by the average investor of these products. Banks know that because of convenience costs many customers will choose not to exercise the embedded options. Banks can thus offer rates above their theoretical levels and still profit since the average investor will remain uninformed and choose not to exercise the embedded options. Consequently, the small rate differential between the flex CD and the traditional CD reflects the small likelihood that the customer will actually exercise the options embedded in the product.

5. Conclusions

A methodology has been developed for valuing enhanced certificates of deposit that contain embedded options. This methodology provides considerable insight into the risks associated with these products as well as an explanation for why banks offer the products in their current form. It is our thought that as the market for these instruments matures, investors will become increasingly informed and prices will begin to converge to their theoretical levels.

The flex CD presents many opportunities for the individual investor. The products provide much flexibility and liquidity, as well as a hedge against adverse interest rate moves. More importantly, to the market astute investor, these deposit products offer more relative value than other traditional products during times of high volatility, as their pricing assumes inefficient exercise of the options embedded within the product. The current products offered are especially attractive, since investors can acquire valuable options while taking relatively small discounts from the Traditional CD rate. This methodology will allow investors to understand the value of the flex CD and its embedded features.

Notes

1. Information and data are from actual banks; however, for privacy reasons, the names of the institutions are not disclosed in this paper.

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