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PERCS, DECS, AND OTHER MANDATORY CONVERTIBLES

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• **M**andatory convertibles such as PERCS and DECS are equity-linked securities that pay a higher dividend than the common stock for a number of years and then convert into common stock at a pre-specified date and have limited appreciation potential. From their modest beginnings in 1988 such mandatory convertibles have become sufficiently popular with issuers and investors to have accounted for a quarter of the 520 billion convertible market in 1996. And the variety of mandatory convertibles seems to increase every year with each new variation designed to satisfy a special demand in the marketplace or to accommodate the special circumstances of different issuers.[1] Carrying names like Morgan Stanley's PERCS and PEPS, Merrill Lynch's PRIDES. Salomon Brothers DECS, and Goldman Sachs ACES, mandatory convertibles have been issued by companies such as Texas Instruments, General Motors, Citicorp, Sears, Kaiser Aluminum, Reynolds Metals, American Express, First Chicago, Bowater, Boise Cascade, K-Mart, James River, and Allstate.

Moreover, mandatory convertibles are not limited to those issued by companies. They have been created by investment bankers in response to investor demand without the company's involvement. 'Synthetic" mandatory convertibles based upon the stock of firms like Merck, Microsoft, Hewlett Packard, and Amgen have been issued under names like ELKS (by Salomon Brothers), YEELDS (by Lehman Brothers), and CHIPS (by Bear Steams).[2]

At the same time, some interesting variations on conventional convertibles and bond-plus-warrants units have also recently become popular in the Euromarket. Among prominent Euro issuers are Roche Holding, Sapporo Brewery, Kobe Electric, Nafinsa, Michelin, Empresas ICA, and Tsurumi Manufacturing. And, as in the U.S., a number of "designer" equity-linked securities have been introduced in the Euromarket. For example, Swiss Bank Corporation has issued bonds plus "knock-out" warrants for Roche Holding and Benetton—packages of securities that share some of the features of the recent American mandatory convertibles.[3] Morgan Stanley has issued synthetic PERCS linked to the performance of SmithKline Beecham, Nafinsa has issued DECS that will be exchanged for the shares of Teléfonos de Mexico it already owns, and Lukoil has issued DECS-type mandatory convertibles.

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1. A convertible is a bond or preferred equity security which can be converted into common stock at the option of the holder.

2. The acronyms stand for the various ways of describing these securities. For example, PERCS is short for Preferred Equity-Redemption Cumulative Stock; PEPS for Preferred Equity-Participation Securities, DECS for Debt Exchangeable for Common Stock or Dividend Enhanced Convertible Securities; PRIDES: Preferred Redeemable Increased Dividend Securities; *ACES*: Automatically Convertible Enhanced Securities; ELKS: Equity-Linked Securities; YEELDS: Yield Enhanced Equity Linked Securities; and CHIPS: Common Higher Income Participation Securities. The acronyms and complete names are trademarks of their designers. PERCS[TM] is a trademark of Morgan Stanley and Co. DECS[SM] is a service mark of Salomon brothers Inc.

3. A knock-out option is an instrument that loses some option feature upon the price of the underlying security reaching a certain level.

In this article I begin by discussing the rationale for mandatory convertibles from the point of view of issuers as well as investors. In general, convertibles securities reduce the costs of "information asymmetry" that can make equity offerings especially expensive for some smaller, high-growth companies (or any firm with little additional debt capacity where management is convinced its shares are undervalued). Mandatory convertibles play a similar role for larger, often highly leveraged or financially troubled, companies that are seeking equity capital, but want to avoid unnecessary dilution. Much as convertibles accomplish for smaller growth firms, mandatory convertibles enable large issuers with growth (or recovery) prospects that may not be fully reflected in their current stock prices to "signal" their confidence. (In designing "synthetic" convertibles, by contrast, investment bankers are choosing larger growth companies like Microsoft and Amgen that tend to avoid issuing securities with appreciable interest or dividend requirements.)

After describing their potential benefits for investors and issuers, I go on to describe the main features and the valuation of three classes of these securities: PERCS, DECS, and mandatory convertibles with a value guarantee. For each of these three types, I present a fairly simple valuation method—one that decomposes the securities into three basic components that are each readily valued individually: (1) the current value of the underlying common stock; (2) the fixed-income cash flow; and (3) the stock options embedded in the security.

A SAMPLER OF MANDATORY CONVERTIBLES

- **PERCS**. In October 1992, Citicorp issued $1 billion of PERCS at $14.75, which was also the price of its common stock at the time. The PERCS paid an annual dividend of $1.217 (or 8.25% of the issue price) while Citicorp's common was paying no dividend. In addition, the PERCS were required to be converted into common stock on November 30, 1995, with the value of the common stock issued per PERCS not to exceed $20.28.
- **DECS**. In October 1993, American Express issued $772 million of DECS at $36.75, the price of First Data Corp. common stock. (FDC was formerly a wholly-owned subsidiary of American Express that had been taken public in 1992, and American Express still owned 21.5% of the stock at the time of the DECS issue.) The DECS paid a coupon of 6.25% on notes that had to be exchanged on October 15, 1996 for First Data common stock. The exchange rate was set at one common share per DECS if the maturity price of the stock was less or equal to $36.75; for a maturity price between $36.75 and $44.875, the exchange rate was defined such that the exchange value of the common would equal $36.75; and, for a maturity price greater or equal to $44.875, the exchange rate was 0.819 common shares per DECS, thus allowing the holders to receive 81.9^{0}/o of the price appreciation above $44.875. The DECS issue enabled American Express to liquidate its position in FDC without triggering capital gains taxes (which were put off until the maturity date of the DECS), while at the same time deducting the interest paid on the exchangeable notes from its current taxable income.
- **Bonds with Knock-out Warrants**. In July 1993, Benetton issued 200 billion lira of bonds with three-year knock-out equity warrants. The warrants could be exercised at L17,983, which was 96% of the common stock price at the time of the issue, and they gave the investor the option to receive common stock on a one-to-one basis as long as the stock price was less than or equal to L29,873. Above this price, each warrant was to receive a fractional share with value equal to L29,873, thus capping the appreciation potential of the security. In addition, Benetton guaranteed a maturity price of not less than L21,543, thereby guaranteeing investors a minimum appreciation of 15%. However, if the share price exceeded the "knock-out" price of L24,353 any time during the life of the warrants, the downside protection would disappear (i.e., be "knocked out").
- **Tax-deductible PERCS**. In October 1996, SunAmerica issued $375 million of tax-deductible 8% PERCS Units.[4] Tax deductibility was accomplished by issuing a forward purchase contract for common stock of the company sold to equity investors. The proceeds from these purchase contracts were used to purchase U.S. Treasury Notes on behalf of the holders, which in turn were pledged with a depository as collateral to the purchase contract. The holders will receive the interest on the

4. PERCS in this ease was defined by Morgan Stanley to stand for 'Premium Equity Redemption Cumulative Security units' in order to differentiate it from the original non-tax-deductible form

Treasury Notes plus a supplement paid by the issuer. In addition, SunAmerica issued $375 million of 6.2% notes to fixed-income investors. At settlement, the issuer can use the proceeds from the forward purchase contract to pay off the principal of the notes. This structure provided SunAmerica with both equity treatment by the rating agencies and a tax shield from the interest paid on the notes.

EXPLAINING THE DEMAND FOR MANDATORY CONVERTIBLES

Mandatory convertibles, and convertibles in general, have reached record levels in recent years as new issue volume exceed redemptions of dollar-denominated convertibles by almost $5 billion in 1995 and 1996. New issues of DECS alone exceeded $5 billion during this period, with more than $3 billion accounted for by issues exchangeable into the securities of units divested by the issuers. What would account for the recent surge in their popularity?

On the demand side, investors are seeking current yield, capital appreciation, or some combination of the two depending on the their cash requirements and tax situation. In addition, for any given return they attempt to minimize their risk by seeking downside protection and liquidity. With the recent decline of interest rates and dividend yields, those investors seeking higher current income created a demand that could be met by those issuers willing to offer a higher dividend yield than that provided by their common stock.

Issuers, on the other hand, attempt to offer less of some or all of these attributes sought by investors. The role of the banker is to design a financial instrument that fits into the financial plan of the issuer and falls within the set of securities demanded by investors at a particular point in time. Securities that are popular with investors attract market makers, who in turn provide liquidity and pricing with narrow bid-ask spreads.[5]

To some extent, there is always a gap between the information possessed by issuers and investors with respect to the risks or the appreciation potential of a security. Equity-linked securities are particularly appropriate for closing that gap because their value is less sensitive than either conventional (straight) bonds or stocks to changes in the risk of the issuer. Investors holding convertibles of firms that become riskier after issuance of the securities experience two offsetting effects: although their claim to income decreases in value, their option on the company stock built into the convertible becomes more valuable because of the higher volatility of the stock.[6]

This argument, which applies to mandatory as well as ordinary convertible securities, may be especially useful in explaining the appeal of "synthetic" mandatory convertibles to investors. The investment bankers that have been concocting such securities for their investors have likely discovered that investors are willing to pay a price greater than the value of the sum of the parts (a "financing synergy," if you will) when a high-income stream is combined with a certain amount of upside potential associated with "glamour" firms like Microsoft, Merck, and Amgen.

But how does this "financial synergies" argument apply to those mandatory convertibles actually issued by corporations? To see why information asymmetry can become an important financing concern, imagine you are the treasurer of a Fortune 500 company that is already fairly highly leveraged, and that your firm has recently experienced a sharp downturn in earnings. Assume further that, although management is convinced the downturn will be fairly temporary, your stock price is trading at only half its former high. (Think of Citicorp in 1992, for example, when its stock price had fallen well below $15 from a former high of over $35.)

In these circumstances, your company—like the smaller high-growth firms that often issue ordinary convertibles—would generally prefer to issue new equity rather than debt. But, like many high-growth issuers of convertibles, you face an information problem: In management's view, the current stock price does not reflect the firm's longer-term prospects, and so issuing equity would cause exces-

5. The relationship between the firm's value and the size of its investor pool is examined in Merton, "A Simple Model of Capital Market Equilibrium with Incomplete information," *Journal of Finance*, Vol. 42, July 1987. See also Yakov Amihud and Haim Mendelsohn, "Liquidity and Cost of Capital Implications for Corporate Management," *Journal of Applied Corporate Finance*, Vol. 2 No. 3 (Fall 1989).

6. This property of convertibles was first noted by Michael Brennan and Eduardo Schwartz, "The case for Convertibles," *Chase Financial Quarterly*. Spring 1982. Reprinted in *Journal of Applied Corporate Finance*, Vol. 1 No. 2 (Spring 1988).

There is always a gap between the information possessed by issuers and investors with respect to the risks or the appreciation potential of a security. Equity-linked securities are particularly appropriate for closing that gap.

sive dilution of the existing shareholders' value. Moreover, just announcing the firm's intention to issue equity in these circumstances would probably depress the stock price further, thus resulting in further dilution.

This justification for mandatory convertibles applies to a number of issuers in the early '90s, including General Motors and RJR Nabisco as well as Citicorp, each of which felt compelled to restructure their balance sheets because of their high levels of debt combined with low equity valuations. At the time of their mandatory convertible issues, each of these three companies had become relatively risky firms in the view of investors. And, in order to reduce the information costs that come with the issuance of common equity in such circumstances, it was natural for them to offer mandatory convertibles instead. In exchange for paying higher dividends during the initial years, these issuers were able to issue less costly, "delayed" common equity, while receiving full (or nearly full) equity credit from rating agencies and regulators.

In such cases, mandatory convertibles have a number of benefits:

- When compared to an issue of straight subordinated debt, mandatory convertibles limit excessive financial (default) risk by substituting preferred dividends for interest payments for a period of just a few years. Because the preferred dividends can be waived and accumulated if the downturn proves worse than expected, mandatory convertibles are typically viewed as equity equivalents by the rating agencies.
- Mandatory convertibles reduce the negative signaling "effect," and the resulting dilution of value, associated with conventional equity offerings. By using the promise of several years' higher income to limit investors' participation in the upside, the issuance of mandatory convertibles provides a stronger expression of confidence in the firm's future to the investment community. (This is especially true in the case of PERCS, where, as we will see below, the firm is effectively purchasing a call option on its own stock from its new equityholders.)

But the ability of mandatory convertible preferred securities to reduce the costs associated with investor uncertainty is not the only argument for issuing them. The latest versions, as represented by the SunAmerica issue cited at the beginning of this article, also provide tax benefits relative to conventional equity. Tax-deductible structures provide a tax shield on most of the fixed charge as well as equity treatment from Moody's and S&P for more than 90% of the issue. Moreover, convertible perpetual preferred stock, when issued by a special purpose trust that in turn lends the proceeds to the company, also permits tax deductibility; but because such securities do not ensure mandatory conversion into equity, they receive lower equity "credit" from rating agencies.

Mandatory convertibles also provide a mixture of income and appreciation that can result in a greater after-tax return to taxable investors than that provided by pure fixed-income securities. This is particularly true for many European investors who enjoy favorable tax treatment of capital gains. Also, the equity risk to which investors are exposed can be reduced by a price guarantee of the kind provided by the Benetton issue described earlier.

VALUING PERCS

Now we turn to the valuation of mandatory convertibles, and let's begin by considering the case of PERCS. The first step in valuing a complex security is to break it down into its most basic components.

A PERCS is made up of three components:

- A dividend cash flow received until the PERCS maturity;
- A common share to be received at maturity;
- A call option on the company's stock written by the PERCS holder to the company.

In equation form,

$$P_K = PV(\text{cv div}) - PV(\text{cm div}) + P - \text{Call}(X) \qquad (1)$$

where P_K is the value of the PERCS, PV is present value, cv div and cm div are the dividends on the convertibles and on the common, respectively; P is the price of the common stock; and Call(X) is a call option on the common stock of the issuer expiring at the PERCS maturity in which the strike price begins at X_0 and decreases at a daily rate until its equals the PERCS cap X at maturity.

The valuation of the first two components is straightforward. The third component reflects the value to the issuer of the cap on the upside appreciation of the PERCS; any further appreciation of the common stock above the cap does not accrue to the PERCS holder. Moreover, the specification that the investor receives a fractional share of common stock

with value equal to the cap at maturity[7] makes a PERCS the equivalent of the following two transactions: (1) the issuer gives the holder a full share of stock and (2) the holder gives the company a call option with strike price equal to the cap.

PERCS Dividend: In valuing the PERCS dividend, one may be tempted to discount it at the yield of the company's outstanding preferred stock, if any, or at the yield of straight preferred stock of comparable companies. But because such yields reflect required returns on assets of long duration, they should not be applied to a cash flow to be received only during the following three years. A better choice is the rate paid by the company on subordinated notes with approximately the same duration as the PERCS dividend. For example, Citicorp's subordinated notes were priced at an 80-basis point spread over Treasuries, or about 5.3% at the time of the PERCS issue. Using 5.3% as the discount rate,[8] one would estimate the expected present value (on October 15, 1992) of the 13 PERCS dividends to be paid over the next 37 1/2 months to be $3. 49.[9]

Common Dividend: Citicorp common stock at issue time was trading at $14.75, but PERCS holders forgo any dividends paid to common stockholders prior to the maturity of the PERCS. Thus, the value of the stock to be received at maturity is the price of the stock at issue time *minus* the present value of the dividends forgone. At the time of the PERCS issue, Citicorp paid no dividend but investors expected Citicorp to reinstate its dividend in 1994.[10] Citicorp annual dividend per share prior to its discontinuation was $1. The common dividend forgone can be discounted at the same rate as the preferred dividend (based on the assumption that the payment of short-term dividends is more certain than the firm's longer-run earnings prospects).[11]

The expected present value of Citicorp quarterly dividends forgone as of October 15 was $1.78. Therefore, the value of the common share minus the dividends forgone was $14.75 minus $1.78, or $12.97. This analysis also implies that the value of the PERCS dividend exceeded that of the common dividend forgone by $3.49 minus $1.78, or $1.71.

Value of the Call Option: We have seen that the cap on the PERCS is equivalent to the holder's having written a call option on Citicorp stock. More precisely, the holder has given the issuer an "Asian" (or average-price) call option,[12] with a payoff that depends on the five-day average price of the underlying stock. The value of the call can be calculated based on the following six parameters:

(1) the strike price ($20.28, which equals the cap value);

(2) the current stock price adjusted for dividends forgone ($12.70);[13]

(3) the time to expiration (3 years and 17 days);[14]

(4) the risk-free rate of interest (4.5%, which was the yield on Treasury Notes maturing 11/95);

(5) volatility (36%, as implied in the pricing of Citicorp CBOE Jan '95 options); and

(6) averaging period (5 days).

The estimated value of the call based on the values assigned to these six parameters is $1.73.[15]

Combining the above results shows the estimated value of Citicorp PERCS at the time of issue to have been $14.73:

	PERCS dividend — Common stock dividend	**$1.71**
+	**Stock price**	**14.75**
–	**Call option PERCS value**	**(1.73)**
		$14.73

7. Actually, PERCS holders receive a number of shares equal to the cap divided by the average of closing prices during the five trading days ending two days before the notice date, which should be at least 30 days before conversion.

8. All rates are expressed in bond equivalent yields.

9. Citicorp's PERS paid thirteen quarterly dividends, the first on November 30, 1992 (for the period October 15-November 29), and successive dividends on February 28, May 31, August 31 and November 30.

10. On October 8, 1992, at a meeting with analysts and investors the week before the PERCS issue, Citicorp's CEO John Reed said Citicorp was likely to resume paying dividend in 1994. See *New York Times*, October 9,1992, p. D1.

11. Strictly speaking, one should discount each year's equity cash flow at a rate reflecting its own equity premium. But since the systematic risk of short-term dividends is close to zero, one can justify discounting them at rates that contain negligible risk premiums.

12. The value of Asian options depends on the value of the asset not at expiration, but rather on the *average* value of a specified time period. For the precise analytic approximation to the value of average options used in this paper, see M. Curran. "Beyond Average Intelligence," *Risk*, November 1992. Reprinted in R. Jarrow, ed., *Over the Reinbow*, Risk Publications, London, 1995, pp. 167-168. The effect of averaging is to reduce the volatility of the option. When the averaging period is large in relation to the maturity of the option, the values of Asian options are significantly lower than those of the corresponding European options. In the case of PERCS, the averaging periods are short, and thus averaging has a small effect on value at the time of issue.

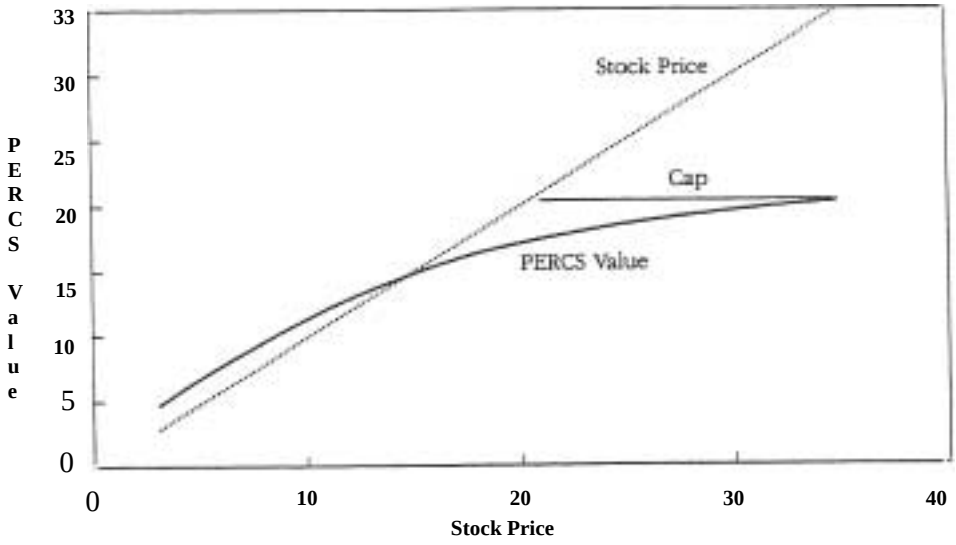
13. The issue of PERCS brings the initial equity of the company to $V = nP + mP_K = (n+m)P$, where m is the number of PERCS issued and n is the number of common shares outstanding prior to the PERCS issue. Subtracting the dividend payments (see for example, J. C. Hull, *Options, Futures and other Derivative* Securities, 2nd. ed., Prentice-Hall, p. 233) yields $V^* = (n+m)P - [nPV(\text{cm div}) + mPV(\text{cv div})]$ which, upon division by n+m gives the price input to use in the call formula $V^*/(n+m) = 14.75 - (68 \times 3.49 \div 366 \times 1.78)/434 - \$12.70$.

14 The effective expiration date of the call is 30-day shorter than maturity. See fn. 7.

15. Citicorp had the right to call the PERCS at any time at the initial price of $23.931, declining by $.003262 each day until it reached the cap. This was taken into account by valuing the PERCS using the approximation suggested by Fisher B lack for Amencan options (in "Facts and Fantasy in the Use of Options," *Financial Analysts Journal*, July-August 1975, pp. 36-41 and 61-72). The value of the call corresponds to the minimum value of the PERCS, which in this case is assumed at expiration.

Convertible securities reduce the costs of "information asymmetry" that can make equity offerings especially expensive for some smaller, high-growth companies. Mandatory convertibles play a similar role for larger, often highly leveraged or financially troubled, companies that are seeking equity capital, but want to avoid unnecessary dilution.

FIGURE 1
VALUE OF CITICORP PERCS



The PERCS were issued at $14.75, the closing stock price on October 14, 1992. And, in fact, mandatory convertibles are typically designed so as to have the same value as the common stock at the time of issue. The common stock price is a natural choice for the initial value of these securities because they are contracts that obligate the buyer to purchase the common stock on a deferred basis.[16]

The value of Citicorp PERCS as a function of the common stock price is presented in Figure 1.

DESIGNING MANDATORY CONVERTIBLES

PERCS issuers face a tradeoff between providing investors with higher dividend income or greater potential price appreciation. The higher the preferred dividend relative to the common dividend, the lower the cap investors will accept. Conversely, the lower the preferred dividend, the higher the cap, and thus the greater the potential price appreciation that is required to attract investors.

Of course, the trade-off is operative only within limits. In fact, for an exercise price X that is sufficiently high, the cap is effectively removed, with Call(X) ≈ 0 and PV(cv div) ≈ PV(cm div). In this case, the PERCS would have the same payoff as the common stock and will not be of interest to the yield oriented investors to which the PERCS is directed. On the other hand, a sufficiently high dividend will result in a cap so low that the PERCS effectively becomes a three-year subordinated note with no stock appreciation potential.

As the above logic suggests, we can use the well-known relationship of put-call parity to transform equation (1) for Citicorp PERCS into the following equivalent: a three-year subordinated note minus a put written by the holder to the issuer. Expressed as an equation,

$$P_K = B(\text{cv div}, X) - \text{Put}(X) \qquad (2)$$

where B(cv div, X) = the value of a three-year subordinated note paying a quarterly coupon equal to the PERCS dividend and having face value due at maturity equal to X, the PERCS cap;[17] and Put(X) = a put on the common stock of the issuer expiring at the PERCS maturity date with strike price X.

Equation (2) shows how simple it is for investment bankers to create synthetic mandatory convertibles, such as the issues of ELKS, YEELDS, and CHIPS mentioned earlier, without the need for an original issuer. In principle, a banker can supply PERCS-like instruments on any public company and

16. The discrepancy between the valuation above and the actual issue price may be due to a slight overestimation of the volatility of the call. The implied volatility of the PERCS priced at $14.75 is 35.8%. Note that the expiration date of the CBOE options on which the volatility is based is 283 days shorter than the PERCS. Available empirical evidence suggests that volatility is smaller for longer maturities. See M. Rubinstein, "Nonparametric Tests of Alternative Options Pricing Models Using All the Reported Trades and Quotes on the 30 Most Active CBOE Options Classes from August 23, 1976 through August 31, 1978," *Journal of Finance*, 40, June 1985, pp 455-480.

17. The principal of this note is essentially riskless because there is no uncertainty concerning the settlement of the PERCS at maturity.

be fully hedged as long as it can buy B(cv div, X) and sell Put(X). But, since subordinated notes on firms like Amgen and Microsoft generally don't exist, the banker can instead hedge its synthetic issue (as suggested by equation (1)) by buying the underlying stock with the proceeds of the issue, selling Call(X), and using the call proceeds and the common dividend, if any, to fund the preferred dividend. In fact, these transactions can be made by fund managers themselves if they are allowed to buy common stock and trade stock options.

Mandatory convertibles also permit the construction of synthetic fixed-income securities. Equation (2) shows that an investor can achieve a position with payoffs identical to those of B(cv div, X) by buying a PERCS and a put. In fact, companies such as Intel have been reported to engage in these transactions when investing temporary cash balances. Intel would buy, say, Citicorp PERCS along with puts on Citicorp stock, thereby achieving a higher yield than that of a corresponding Citicorp note.[18] An investor contemplating such a transaction should compare the yield (net of transaction costs) of the investment in the PERCS and the put to the yield of a subordinated note with the same duration, risk, and liquidity.

FROM PERCS TO DECS

Investors with bullish expectations may not be attracted to equity derivatives such as PERCS because of their cap on appreciation potential. Additional appreciation can be added to the instrument by including out-of-the-money calls on a fraction of the company stock. This change produces the instrument variously called DECS, PEPS, PRIDES, or ACES.

The value of a DECS is given by:

$$\mathbf{P_D = P_K(X_1) + aCall(X_2)} \qquad \mathbf{(3)}$$

where $P_K(X,)$ is a PERCS with cap X_1, Call(X_2) is a call on the company stock with a strike price X_2, that is greater than X_1, and a is the number of calls attached to the instrument ("a" is usually set equal to P/X_2, which is less than one, in order to limit the the upside to some fraction of the appreciation). As in the case of PERCS, DECS are generally issued with a price per unit equal to the current stock price. But, as just noted, DECS do not begin to participate in stock price appreciation until the stock price reaches a level (X_2) higher than the current price.

Substituting equation (1) into equation (3) and taking into account that, in practice, $X_1 = P$ and $a = P/X_2$ yields the following:

$$P_D = \mathbf{FV(cv\ div) - PV(cm\ div) + P - Call(P) + (P/X_2)Call(X_2),}$$

which provides a straightforward way to value the DECS.[19]

Another feature of DECS is that the "maturity price" used to determine the share fraction to be received for each DECS is the average closing price during the 20 trading days immediately prior to the DECS maturity. The longer averaging period reduces the volatility of the Asian calls and, hence, their value.

Moreover, the fraction of the share received by the DECS holder varies with the maturity price. If we designate the maturity price as M, then the holder receives one common share if M is less than or equal to P; M/P of a share if M is greater than or equal to P but less than X_2; and P/X_2 of a share if M is greater than or equal to X_2.

The value of DECS can be broken down into the following components:

- A preferred dividend (or interest) until expiration;
- One share of common stock received at expiration;
- A call with strike price P, written by the holder to the issuer;
- A fraction P/X_2 of a call with strike price $X_2 > P$, written by the issuer to the holder.

Since the DECS are initially priced at the common stock price, the designer of a DECS issue can choose only the level of the dividend or the strike price. An increase in the DECS dividend means a higher exercise price, X_2, on the call. Conversely, a lower dividend requires that investors be granted price appreciation at a lower strike price.[20]

To illustrate, if instead of PERCS Citicorp had issued DECS with the same coupon and at a price

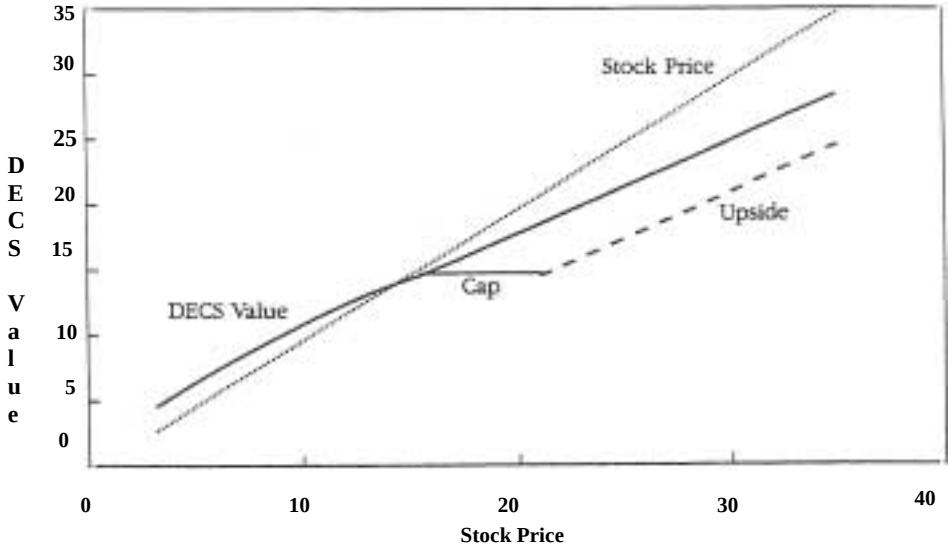
18. "A Black Hole in the Balance Sheet," *Business Week*, May 16,1994, 80-82.

19. An alternative expression is attained by substituting (2) into (3): $P_D = B(cv\ div, P) - Put(P) + (P/X_2)Cal(X_2) = PV(cv\ div) + PV(P) - Put(P) + (P/X_2)Cal(X_2)$, which decomposes the DECS into a fixed income security with principal P paying the preferred dividend rate minus a put with strike price P plus P/X_2 of a call with strike price X_2.

20. Another degree of freedom can be attained by allowing a to change, that is, by giving up more or less than a fraction P/X_2 of the out-of-the money call.

The investment bankers that have been concocting synthetic mandatory convertibles have discovered that investors are willing to pay a price greater than the value of the sum of the parts when a high-income stream is combined with a certain amount of upside potential associated with "glamour" firms like Microsoft, Merck, and Amgen.

FIGURE 2
VALUE OF DECS



of $14.75 per unit, the value of each component *given* a strike price X_2 = $20.79 would have been as follows:[21]

	DECS dividend – Common stock dividend	**$1.71**
+	**Stock price**	**14.75**
–	**One call with strike price = $14.75**	**(3.04)**
+	**P/X_2 = .709 of a call with strike price = $20.79**	**1.33**
	DECS value	**$14.75**

The value of this DECS as a function of Citicorp's common stock price is shown in Figure 2.

MANDATORY COVERTIBLES WITH A VALUE GUARANTEE

An issuer can signal management's confidence about the future performance of its stock by adding a floor to the PERCS value, which is equivalent to giving the holder a put with exercise price at the floor.[22] The knock-out warrants issued in the Euromarket have a put that disappears if the stock price rises to a certain level called the "knock-out" price.[23] This type of issue will be attractive to conservative investors more interested in downside protection than in the out-of-the-money upside provided by DECS.

Adding a put increases the number of features the user can vary in designing the instrument to attract investors. In exchange for providing downside protection to the investor, the issuer can either put a lower cap on appreciation, reduce the dividend, or take some combination of these two steps. For this reason, the Euromarket versions were issued with low coupons and targeted at capital gains-seeking investors. Moreover, as in the case of PERCS and DECS, mandatory convertibles with a value guarantee are likely to be treated as equity by rating agencies because the downside protection does not involve a return of principal, but rather a dilution of other stockholders' claims.

Let us examine a PERCS with a value guarantee in more detail. It can be expressed as a conventional PERCS plus a put as follows:

$$\mathbf{Pp = P_K + Put\ (X_0, K),}$$

which can in turn be broken down further as follows:

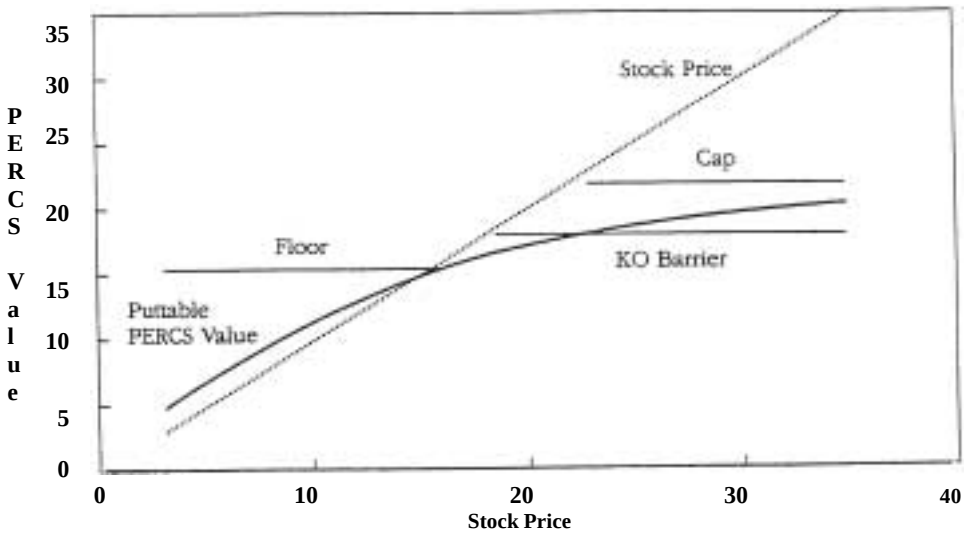
$$\mathbf{Pp = PV(cv\ div) - PV(cm\ div) + P - Call(X_1) + Put\ (X_0, K)}$$

21. The price input into the Call(P) formula is as in footnote 13. But the price input into Call(X_2) is attained by dividing V^* by the number of shares to be outstanding if this call is exercised, that it, by n + am. X_2 is then obtained as the solution to $(P/X_2)Call(V^*/[n+(P/X_2)m], X_2) = Call(V^*/(n+m), P) - [(PV(cv\ div) - PV(cm\ div)]$ in order to make $P_D = P$.

22. This means that for a strike price X_0 the PERCS holder will receive $(X_0/P)m$ shares if $P < X_0$ at expiration.

23. Knock-out options are discussed in J. C. Cox and M. Rubinstein, *Option Markets*, Prentice-Hall. 1985. pp. 408-412, J. C. Hull, *op.* cit., 418-420, and M. Hudson, "The Value of Going Out," *Risk*, March 1991, reprinted in Risk/Finex, ed., *From Black-Scboles* to *Black Holes*, Risk Publications, London, 1992, pp. 183-186.

FIGURE 3
VALUE OF KO. PUTTABLE PERCS



where Put (X_0, K) is a put with strike price at a floor (X_0) somewhat above the issue price (P) and a knock-out price (K) higher than the floor price, but less than strike price on the call. Removing K results in a regular put. The floor gives two additional choices to the designer of the issue. In a PERCS with a value guarantee, the issuer can choose three parameters out of the four that characterize the instrument: dividend, cap, floor, and knock-out.

To illustrate, let us return to the Citicorp PERCS and reduce its dividend from $1.217, or 8.25%, to 30 cents per year, or 2%. Investors could be compensated for this reduction in the dividend by a certain amount of guaranteed appreciation. Let's say the floor will be $15.50, or $0.75 above the issue price, and the knock-out price is $17.70. The choice of these two parameters results in the following values being assigned to the components of the PERCS:
(1) PV(cv div) = $0.86 and (2) Put ($15.5, $17.7) = **$2.57.**[24] These two calculations in turn allow us to calculate the value of the cap as follows:

Call (X_1) = PV(cv div) – PV(cm div) + Put ($15.5, $17.7)

= 0.86 – 1.78 + 2.57 = $1.65.

This value of the cap in turn implies a strike price for the cap (X_1) of $21.80.

Thus, the value of the PERCS with a value guarantee is made up of the following components:

Convertible dividend – Common stock dividend	**$(O.92)**
+ Stock price	**14.75**
– Call with strike price = $21.80	**(1.65)**
+ Put with strike price = $15.5 and knock-out = $17.7	**2.57**
Puttable PERCS	**$14.75**

In sum, investors in these PERCS receive a 2% annual coupon plus 5.1% guaranteed appreciation plus the possibility of a further 41% appreciation. But, once the stock appreciates by 20% or more, the guarantee would disappear. The role of this knockout provision is to lower the value of the put in order to provide room for a higher floor, a higher dividend, and/or upside appreciation. For example, removing the knock-out from this issue would increase the value of the put to $3.54, leaving little room for the dividend or upside potential.

A put can also be added to a DECS in order to provide unlimited upside with some downside protection. The value of a puttable PERCS as a function of Citicorp's price is presented in Figure 3.

SUMMARY

Mandatory convertibles such as PERCS and DECS allow highly leveraged (or temporarily troubled) companies to restructure their balance sheets by helping to control the "asymmetric information" problem that can make conventional equity issues very expensive. When made

24. Here the price input becomes $V^*/[n+(X_0/P)m]$ in order to account for the number of shares that will be outstanding if the put is exercised.

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exchangeable into the stock of a partially divested unit, they also allow issuers to liquidate their remaining holdings in the unit while putting off capital gains taxes. In recent years, investment bankers have also been constructing "synthetic" mandatory convertibles that give investors hybrid claims that combine income and equity-like payoffs based on the performance of companies such as Microsoft and Amgen—companies that rarely issue income-producing securities. While PERCS and DECS are the most popular forms of mandatory convertibles in the U.S., overseas issuers have also been issuing variations such as bonds with knock-out warrants that offer investors lower coupon rates but guarantee a certain amount of price appreciation. Like their U.S. counterparts, these innovative securities also are designed to signal management's confidence about the firm's prospects and so avoid the dilution associated with conventional equity offerings.

Mandatory convertibles allow the issuer (or an investment bank) to tailor the payoffs to the requirements of investors. PERCS offer high income and limited appreciation, and DECS offer high income with no immediate appreciation but unlimited upside. If investors have a preference for capital gains, convertibles with a value guarantee offer some appreciation while permitting issuers to reduce the current income component of the payoff. Attaching a knock-out barrier reduces the value of the guarantee and allows the issuer to offer a higher dividend, more price appreciation, or both, By choosing the appropriate mandatory convertible, investors can receive the payoff in the form that best suits their investment goals and their tax and regulatory situation.

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