Chapter 13: Other Derivatives and Markets

A. Swap Contracts

A huge variety of other types of derivative securities exist for a number of purposes, including hedging, speculating and arbitrage. One important type of derivative, a *swap contract*, provides for the exchange of one set of cash flows for another set of cash flows. The amounts of these cash flows are usually tied to cash flows associated with other assets or portfolios. Swap contracts are specified for commodities, currencies, debt and equity securities, interest rates and many other types of assets as well.

Swap contracts have many uses. For instance, swap contracts enable financial market participants to synthesize other securities which are either unavailable or inappropriately priced. For example, Japanese regulations have, in the past, restricted investment in many types of securities; in particular, Japanese institutions have been restricted with respect to non-yen bond purchases. Suppose that a firm wished to borrow dollars to purchase American products. Japanese tax code often makes borrowing less expensive in Japan. The borrower could sell to a Japanese institution a yen denominated bond (resulting in an attractive interest rate due to preferential tax treatment of Japanese zero coupon notes) then execute a dollar/yen currency swap such that its initial loan receipts and loan repayments are denominated in dollars. Thus, all the borrower's net cash flows are denominated in dollars (it has synthesized a dollar loan) and the Japanese institution fulfills regulatory requirements by issuing a yen denominated note.

<u>Examples of Swap Contract Types</u>

A *total return swap* is a tradable contract that provides for one party to make a payment based on the total economic performance of a specified asset in exchange for some other fixed or variable cash flow. That is, in the context here, the payments between contracting parties to a total return swap are based upon changes in the market valuation or rate related to a specific credit instrument, irrespective of whether a credit event has occurred. A total return swap in effect provides for exchanging an obligation to pay interest at a specified fixed or floating rate for payments representing the total return on a loan (interest and principal value changes) of a specified amount. Interpreted broadly, other types of swap contracts discussed here might also be considered total return swaps.

Interest rate swaps enable counterparties to swap streams of cash flows associated with two or more different debt instruments or interest rates. For example, a floating-to-fixed swap enables one counterparty to make a payment based on a floating interest rate such as the SOFR (Secured Overnight Financing Rate, a reference rate based on overnight repurchase agreement (repo) transactions) in exchange for a payment based on a fixed rate. The payments exchanged between contracting parties to this interest rate swap are based upon changes in the market valuation or rate related to the floating rate credit instrument.

For a more specific example, suppose that a bank enters into a one-year total return swap agreement in which the client pays the Secured Overnight Financing Rate (SOFR) on the notional amount of $1,000,000 in exchange for a fixed rate of 5%. Suppose that after one year the SOFR is 4%. The payment is netted at the end of the swap term with the bank making a payment of $10,000 = ($1,000,000 × (5% - 4%) to the client.[1] In effect, the client has swapped variable interest payments for a fixed rate payment at 5%.

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[1] For a period containing a fraction of a year, the swap payoff would be (Notional Amount × (#Days in Contract/360) × (Fixed Rate - Market Rate).

An *equity swap* is a contract providing for the delivery of cash flows associated with shares of equity or an equity index in exchange for the cash flows associated with another asset such as a debt or index instrument. For example, an investor wishing to relieve herself of risk associated with shares that she is currently holding, without selling and exposing herself to capital gains tax liability under some tax regimes, might agree to deliver to another investor the cash flows (dividends and capital gains for a specified period) associated with her shares. The second investor, in turn, agrees to deliver cash flows associated with a treasury bond to the stock investor. Such equity swaps are used to exploit apparent mispricing in equity markets, to manage risks associated with domestic or foreign equity investment, to circumvent dividend withholding tax requirements in foreign countries, to speculate in foreign equity markets when direct ownership is not permitted, and to avoid tax events or certain corporate transaction reporting requirements.

A *credit default swap* (CDS) provides for one party to pay a fixed premium or series of premiums in return for protection against a specified credit event (e.g., default) or events. A CDS might be used by a lender to arrange for a counterparty to reimburse him in the event of a borrower default. To provide this credit enhancement or insurance, the counterparty accepts a premium or series of premiums for acting as counterparty.

Credit default swaps can resolve for a lender much credit uncertainty, and usually allows for default recovery much faster than court bankruptcy proceedings. The of a resolution borrower default in bankruptcy is never a simple matter. Defaults, debt restructurings and bankruptcies usually take years to resolve and are usually very costly. The International Swaps and Derivatives Association (ISDA, discussed in Chapter 5) process speeds up and governs the way borrower defaults are handled with respect to the many types of CDS contracts. Essentially, the ISDA provides for clear definitions of credit events, the declaration of a default and the setting and design of a bond or debt auction process. This auction can provide for the physical settlement of bonds involved in default, in which impaired bonds can be liquidated and prices can be discovered. This auction process provides the basis for an appropriate cash flow from short to long CDS position holders and allows for much faster resolution for lenders than court bankruptcy proceedings.

Regulation of Swap Markets

The Maloney Act of 1938 and the formation of the NASD launched a significant innovation leading towards some degree of privatization in the regulation of securities markets. The OTC (nonpublic) markets rely on trade associations or nonprofit corporations to prepare uniform contracts and standardized agreements among market participants. For example, in 1987 the International Swaps and Derivatives Association (ISDA), which sets standards for derivative contracts, prepared the then 14-page ISDA Master Agreement that has regulated the huge swaps markets. This relatively short Agreement acts as a standardized contract used among participants in these huge markets and reflects a principles-based regulatory regime for the regulated markets. ISDA and its early success were instrumental to the refusal by Congress to further regulate derivatives markets in the 1990s. When such efforts fail to prevent market stress or failure, government regulators intervene. Major advantages to maintaining private regulatory bodies or self-regulation in securities markets might be as follows:

- Market participants have the most intimate knowledge of the markets to be regulated.
- The regulatory foci on developing best practices and effective monitoring and

enforcement policies are based on economic and reputational self-interest.
• Governmental regulatory costs are reduced as they are passed on to the regulated market.

Swap Execution Facilities

A *swap execution facility* (SEF) is a registered electronic trading system that enables OTC swaps traders to provide and obtain quotes and execute swap transactions by accepting bids and offers. An SEF is in many respects similar to a formal exchange, though the term refers to any distributed group of approved trading systems for swaps but is not regulated as an exchange. SEFs are intended to provide institutional traders enhanced efficiency and transparency to swaps markets along with reduced systemic risk to the overall financial system. Traditionally (before the Financial Crisis of 2008), most OTC swaps were privately negotiated and traded by financial institutions over the telephone. Such trades were usually cleared bilaterally between trade counterparties.

SEFs maintain Central Limit Order Books, which collect quotes from market makers to be disseminated to members. An institution (sometimes called a market taker) seeking to accept one of the orders in the CLOB can execute a transaction at the best available price. SEFs can promote pre-trade transparency by soliciting or assisting in a solicitation of bids and offers through a *request for quote* (RFQ) system. Here, the market taker submits an RFQ (or request for quote stream) to swap market makers, often with assistance of the SEF. Market makers provide quotes, which may or may not be supplemented by the CLOB. Then, if the market taker accepts a quote, the trade is executed through the SEF and reported in compliance with established facility rules to enhance competition, fairness and transparency. Traders are monitored for adherence to rules and most trades are centrally cleared to standardize and mitigate fragmented counterparty risk. Once a swap contract becomes traded on a facility, SEFs continue to provide quotes and execution services for that contract, enhancing liquidity and transparency for swaps market participants.

The intermediation by a SEF between two counterparties in a swap agreement is intended to allow risk shifting by the two counterparties to a trustworthy institution that can take both sides of the transaction. The fairly large number of SEFs, such as those managed by TP ICAP, ICE Swap Trade, Tradeweb and Bloomberg are regulated by the SEC (for security-based swaps) and the CFTC. The CFTC maintains a list of registered facilities at https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities. These facilities are a product of Title VII of the 2011 U.S. Dodd-Frank Financial Reform Act, which mandates most OTC swaps to be cleared and traded through such facilities if they are not listed on a designated contract market such as an exchange. As we will discuss in the next chapter, Title VII of the Dodd-Frank Act was largely the result of the relative success after the 2008 meltdown of Lehman Brothers in recovering Lehman positions that had cleared with LCH.Clearnet Group's clearinghouse relative to positions that had not cleared through a clearinghouse. There are exceptions to regulatory facility clearing and trading requirements, such as for highly illiquid and bespoke swap contracts that tend not to be made available to trade.

Most U.S. swap transactions are executed and cleared by swap execution facilities. Financial institutions obtain authorization to serve as swap execution facilities by meeting requirements set forth by Dodd-Frank, the SEC and the CFTC and by submitting a formal application to the SEC.

B. **Structured Finance and Derivative Instruments**

A *derivative instrument* is a financial contract or security whose payoff function is derived from the value of some other security, rate, or index. Derivatives are used for a variety of purposes, including to manage, hedge or transfer risks, to speculate and leverage returns and to arbitrage markets. Derivatives include options, forward, futures and swap contracts and many instruments that we will discuss below that arise from structured finance.

Structured finance concerns the creation of financial processes and instruments needed to serve borrowers and lenders. Structured finance activities often involve somewhat unconventional activities such as the pooling of debts such as loans, credit card receivables, leases, bonds and mortgages, then repackaging these pools into securities to place among investors. This process to issue of these claims against the pools as tradable instruments is known as securitization. *Securitization* is the process that converts illiquid assets into tradable assets. U.S. Federal government sponsored enterprises are often directly involved in these activities along with banks, investment banks, investment companies and other institutions.

Securitized Instruments

Securitized instruments or *asset backed securities* (ABS) are created from pools or portfolios of debt instruments, which are restructured to be marketed as tradable instruments. Securitization can increase the participation and risk-taking by a wider range of investors in otherwise illiquid debt instruments such as mortgages, while enabling banks to liquidate such illiquid assets and more readily alter their balance sheet risk structures.

MBS

A mortgage-backed security is a securitized instrument representing claims on underlying debt instruments that are backed by mortgages. That is, a *mortgage-backed security* is a securitized instrument whose payoffs draw from instruments that are backed by a pool of mortgages. Securitization creates value for lenders by improving the liquidity of their assets, enhancing the potential for diversification and asset portfolio risk reduction and increased funding for increased mortgage lending. Securitization creates value for investors by broadening their investment opportunity sets by enabling them to invest in additional classes of securities with varying risk and return levels. These value enhancements brought by securitization increase the credit availability to borrowers.

Agency issued mortgage-backed securities are guaranteed by a government agency (e.g., GNMA) or a Government Sponsored Enterprise (e.g., FNMA). A mortgage-backed security that is not guaranteed by an agency or GSE is referred to as a non-agency or "private label" issue. Earlier, we briefly mentioned conventional-nonconforming mortgages, which do not conform to purchasing standards of the GSEs but are securitized and perhaps guaranteed by other financial institutions. These mortgage-backed securities can be called “private-label” mortgage securities, as they are issued by private institutions such as subsidiaries of investment banks, banks and real estate investment trusts.

Non-mortgage ABS

There are many other types of debt pools underlying asset-backed securities (ABS), including student loans, auto loans, credit card receivables, trade receivables, aircraft and equipment leases and home equity loans. Other financial asset classes underlying these pools can include equities and equity indexes, commodities and currencies. More general asset types underlying securitized instruments have included real assets such as cell towers, as well as intangible assets such as tobacco settlements and celebrity bonds, the latter of which being formed from pools of royalties from music and song-writing celebrities, including most famously, *Bowie bonds*, securitized from pools of royalties on a variety of David Bowie songs.

Pass-through Instruments

A *pass-through instrument* associated with a pool of mortgages is said to "pass through" mortgage payments to secondary market investors. Essentially, the originating institution or sponsor seeks to securitize the mortgages by creating pass-through or participation certificates securities that reflect fractional ownership in the pool of mortgages. Mortgage pools are packaged and sold by the sponsor into bankruptcy-remote entities called *special purpose vehicles* (SPVs), in this case, sometimes called single-purpose entities. The SPV protects the sponsor and the pool from significant economic damage in the event of failure of the other, and pays for the securitized mortgages with the proceeds of the sale of the securities to the general public.

The sponsor arranges for servicing of the pass-through securities, whereby the *mortgage servicer*, over the lives of the mortgages in the pool, collects payments from the pool and passes them through to the owners of the pass-through securities. Thus, servicers accept and record mortgage payments, calculate interest payments on adjustable-rate loans, pay taxes and insurance as appropriate, manage escrow accounts, take corrective action in the event mortgage default and engage in the foreclosure process when necessary.

In addition, the sponsor or originating institution arranges for credit ratings and for a trustee, whose primary responsibility is to protect the rights of the purchasers and subsequent owners of the securitized instruments. Thus, pass-through instruments are created from mortgages privately issued by banks that are passed through as securities to investors.

Three GSEs, Ginnie Mae, Fannie Mae and Freddie Mac have been and continue to be major participants in the mortgage pass-through business. These institutions pool and securitize mortgages that conform to their underwriting requirements. Non-conforming mortgages, that is, mortgages issued by banks that failed to meet agency underwriting standards, including many sub-prime mortgages, were pooled and securitized by a variety of commercial banks, investment banks and other financial institutions.

Collateralized Debt Obligations

A *collateralized debt obligation* (CDO) is a marketable instrument by which specified events determine the payouts associated with multiple classes of holders of debt-backed assets. Whereas pass-through securities described above represent fractional claims on interest and principal payments associated with a pool of mortgages, the CDO restructures the pool payouts differently.

Essentially, the investment bank creating the CDOs (or more specifically, in this example, *collateralized mortgage obligations*, a type of CDO) place a series of mortgage-backed securities into a trust or special purpose entity (SPV) and repackages the series into tranches (plural form of the French word for slice), each offering a series of payments that depend on terms specified by contract. For example, the contract involving three tranches might call for "Tranche 1" or the senior tranche to receive its full share of contracted payments before any other tranche is paid. Once the senior tranche is fully paid, "Tranche 2," or the mezzanine tranche, receives its full share of payments if enough money is available in the pool. Otherwise, the mezzanine tranche receives the residual of the pool after the senior tranche is paid. "Tranche 3," or the subordinate tranche, receives the residual of the pool after the first two tranches have received their full payments. In a typical securitization, the subordinate tranches, first-loss investors would absorb losses of up to roughly 3% of the value of the pool, mezzanine tranches would absorb the next roughly 5-7% and senior tranches would absorb all remaining losses. As described above, first-loss investors would absorb losses until they received nothing, then would mezzanine investors. Investors can select from these tranches securities that fulfill their own return-risk tradeoff preferences. The tranches remained backed by the real estate collateral along with any relevant federal or private mortgage insurance but claims to the collateral in the event of default are prioritized by tranche rankings. The securities created from the repackaged pool of mortgages are then sold in secondary markets. Figure 6.1 depicts a listing of tranches and other details from securities offered on a sample pool of mortgages. Notice that tranche yields increase as ratings worsen.

The benefits to the banking system of securitization and these securitized instruments are due to the ease of banks being able to sell their mortgages, thereby releasing core capital, which facilitates being able to issue additional mortgages, and being able to convert illiquid mortgages into liquid and marketable securities. This enhanced mortgage liquidity enables banks to produce higher turnovers on their mortgages, increasing their mortgage-related revenues, as well as offload mortgages from their mortgage portfolios. Securitization enables banks to raise capital and to transfer risk off of their balance sheets. In addition, securitization enables investors to broaden their investment opportunity sets and better select from tranches that better satisfy their return and risk preferences.

Credit enhancement of senior tranches can be enhanced by the mortgage pool sponsor several ways. First, the sponsor can over-collateralize the securities or create a reserve fund as additional protection for the senior tranches. Second, the sponsor can issue fewer senior trances along with more mezzanine and/or subordinate tranches. Finally, the sponsor can provide for insurance, surety bonds or letters of credit against credit risk for the senior tranches.

During the late 1990s and early part of this century, use of structured lending increased dramatically, much of it bolstered by favorable ratings by credit reporting agencies. So what went wrong? We know that securitization played a major role in the financial crisis of 2008. As we will elaborate in the next two chapters, banks failed to screen mortgage applicants properly in the mortgage initiation process and attracted unqualified mortgage applicants that failed to fulfill their mortgage obligations over the long term. Initiating banks securitized and offloaded the mortgages onto secondary market investors, while the favorable credit ratings issued by leading credit reporting agencies led to overvaluation and a subsequent bubble and crash. Since mortgage-issuing banks intended to offload these mortgages as quickly as possible, they had little incentive to properly screen them at application. As we will discuss in the next two chapters, post-financial crisis legislation contains requirements that banks offloading mortgages from their balance sheets retain some of the associated credit risk.

FINANCIAL CRISIS INQUIRY COMMISSION REPORT

Selected Investors in CMLTI 2006-NC2

A wide variety of investors throughout the world purchased the securities in this deal, including Fannie Mae, many international banks, SIVs and many CDOs.

	Tranche	Original Balance (MILLIONS)	Original Rating[1]	Spread[2]	Selected Investors
SENIOR 78%	A1	$154.6	AAA	0.14%	Fannie Mae
	A2-A	$281.7	AAA	0.04%	Chase Security Lendings Asset Management; 1 investment fund in China; 6 investment funds
	A2-B	$282.4	AAA	0.06%	Federal Home Loan Bank of Chicago; 3 banks in Germany, Italy and France; 11 investment funds; 3 retail investors
	A2-C	$18.3	AAA	0.24%	2 banks in the U.S. and Germany
MEZZANINE 21%	M-1	$39.3	AA+	0.29%	1 investment fund and 2 banks in Italy; Cheyne Finance Limited; 3 asset managers
	M-2	$44.0	AA	0.31%	Parvest ABS Euribor; 4 asset managers; 1 bank in China; 1 CDO
	M-3	$14.2	AA-	0.34%	2 CDOs; 1 asset manager
	M-4	$16.1	A+	0.39%	1 CDO; 1 hedge fund
	M-5	$16.6	A	0.40%	2 CDOs
	M-6	$10.9	A-	0.46%	3 CDOs
	M-7	$9.9	BBB+	0.70%	3 CDOs
	M-8	$8.5	BBB	0.80%	2 CDOs; 1 bank
	M-9	$11.8	BBB-	1.50%	5 CDOs; 2 asset managers
	M-10	$13.7	BB+	2.50%	3 CDOs; 1 asset manager
	M-11	$10.9	BB	2.50%	NA
EQUITY 1%	CE	$13.3	NR		Citi and Capmark Fin Grp
	P, R, Rx: Additional tranches entitled to specific payments				

[1] Standard & Poor's.

[2] The yield is the rate on the one-month London Interbank Offered Rate (LIBOR), an interbank lending interest rate, plus the spread listed. For example, when the deal was issued, Fannie Mae would have received the LIBOR rate of 5.32% plus 0.14% to give a total yield of 5.46%.

SOURCES: Citigroup; Standard & Poor's; FCIC calculations

Figure 1: Tranches in a Sample Mortgage Pool, Financial Crisis Inquiry Commission (2011), p. 116

Credit Derivatives

Credit derivatives are tradable contracts created to transfer credit risk between contracting participants. Credit derivatives are used by banks to manage their credit exposure. A key component of the contract defines what constitutes a credit event that will trigger a credit default payment.

Credit Default Swaps (CDS)

Perhaps the best known of credit derivatives is the *credit default swap* (CDS), which is a tradable contract that provides for one party to pay a fixed premium or series of premiums in return for protection against a specified credit event (e.g., default) or events. More generally, a *swap* is a contract between two counterparties to exchange specified periodic cash flows in the future based on some underlying index, price or rate. In the case of a CDS, a lender might contract with a counterparty to reimburse the lender in the event of a borrower default. To provide this credit enhancement or insurance, the counterparty accepts a premium or series of premiums for acting as counterparty.

The resolution of CDS when a borrower defaults is not always a simple matter. Defaults, debt restructurings, bankruptcies and their associated costs often take years to resolve. The International Swaps and Derivatives Association (ISDA) process speeds up and governs the manner in which borrower defaults are handled with respect to the many types of CDS contracts. Essentially, the ISDA provides for definitions of credit events, the declaration of a default and the setting and design of a bond or debt auction process. This auction can provide for the physical settlement of bonds, in which impaired bonds can be liquidated and prices can be discovered. This auction process provides the basis for an appropriate cash flow from short to long CDS position holders.

Interest Rate Derivatives

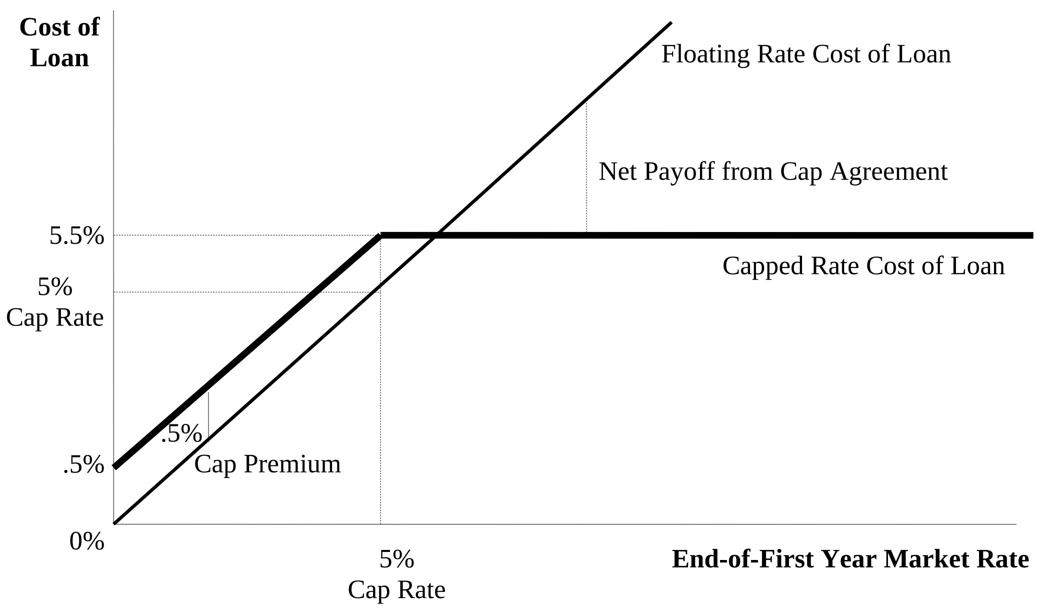
Interest rate derivatives are used by banks and other institutions to manage their interest rate exposure and to generate fee revenues. In the section on credit derivatives, we discussed the use of derivatives primarily to manage credit risk, though the total return swap can be used to manage all sources of risk associated with a credit instrument. Here, we discuss three types of interest rate derivative products that are used to manage interest rate risk.

Caps

A cap is a call option or a series of call options on interest rates that grants its owner the right to receive a payment or payments at the end of each period in which the interest rate exceeds the striking price (cap rate). If the relevant market interest rate were to rise above the cap rate, the writer of the cap compensates the option owner by the notional amount times the difference between the market rate and the cap rate. If the relevant market interest rate does not exceed the cap rate, the writer of the cap pays nothing to the cap owner. The option writer receives an up-front cap premium from the cap purchaser in return for providing this option. The cap can provide for a maximum interest rate that a variable rate borrower would have to pay on a loan.

Suppose, for example, a bank client borrows $1,000,000 for two years at a variable rate. A bank enters a two-year cap agreement with this client in which the bank accepts a premium of 0.5% on the notional amount ($1,000,000) for each of the two years. Thus, the cap agreement has a notional value of $1 million. Assume that the agreement is for a cap rate of 5% with payments settled once a year based on year-end interest rates.

Now suppose that the relevant interest rate rises to 6% at the end of the first year and 7% at the end of the second year. In this event, the writer of the cap (the bank) owes the cap owner (the client) $10,000 = ((6% -5%)×$1,000,000) at the end of the first year and $20,000 = ((7% - 5%)×$1,000,000) at the end of the second year. If the cap premium were .5% of the $1,000,000 notional amount for each of the two years, the capped first year cost of the loan to the client would be a maximum of 5.5% for each of the two years, or $55,000 = ($60,000-10,000+5,000). The cap owner would have paid a $5,000 (0.5%) premium for interest rate protection in each of the two years, for net savings of $5,000 in the first year and $15,000 in the second year. The first year cost and savings to the client is depicted in Figure 6.2. Essentially, a cap is similar to an insurance contract against an increase in interest rates above the cap rate. For each year, the net payoff from the cap agreement itself is MAX [-Premium, Market Rate - Cap Rate - Premium]. Thus, if the first-year market rate is 6%, the net payoff percent from the cap is MAX[-.5%, 6%-5%-0.5%] = 0.5% as depicted in Figure 6.2 for the loan payoff structure. A cap can have one or more than one exercise dates, as the one described here has two.



<u>Figure 2: First Year Cost of Floating Rate and Capped Rate Loans</u>

Floors

A floor is a put option or a series of put options on interest rates that grants its owner the right to receive a payment or payments at the end of each period in which the relevant market interest rate is exceeded by the striking price (floor rate). If the relevant market interest rate were to drop below the floor rate, the writer of the floor compensates the option owner. If the relevant market interest rate is not below the cap rate, the writer of the floor pays nothing to the floor owner. The floor writer receives an up-front floor premium in return for providing this floor option. The floor can provide for a minimum interest rate that a variable rate lender would receive on a loan.

Now, suppose that a bank's client lends $1,000,000 to a third party for two years at a variable rate. The client might wish for some interest rate protection against the rate dropping.

The bank enters a two-year floor agreement with this client in which the client pays the bank a premium of 0.5% on the notional amount ($1,000,000) for each of the two years. Thus, the floor agreement has a notional value of $1 million. The bank has written a put against interest rates and receives a premium from the client. Assume that the agreement is for a floor (minimum) rate of 5% with payments settled once a year based on year-end market interest rates.

Consider the effect of the relevant interest rate dropping to 4% at the end of the first year and 3% at the end of the second year. In this event, the writer of the floor agreement (the bank) owes the floor owner (the client) $10,000 = ((5% - 4%)×$1,000,000) at the end of the first year and $20,000 = ((5% - 3%)×$1,000,000) at the end of the second year. If the floor premium were .5% of the $1,000,000 loan amount for each of the two years, the first-year net revenue (interest receipts and floor payments less the premium) would be a minimum of 4.5% for each of the two years, or $45,000. The floor owner (the client) would have paid a $5,000 (0.5%) premium for interest rate protection in each of the two years, for net revenue of $5,000 in the first year and $15,000 in the second year. The first-year cost and savings to the client is depicted in Figure 6.3. Essentially, a floor is similar to an insurance contract against a decrease in interest rates below the floor rate. For each year, the net payoff from the floor agreement itself is MAX [-Premium, Floor Rate - Market Rate - Premium]. Thus, if the first-year market rate is 4%, the net payoff from the cap is MAX[-.5%, 5%-4%-0.5%] = 0.5%. See Figure 6.3 for the loan payoff structure. A floor can have one or more than one exercise dates, as the one described here has two.

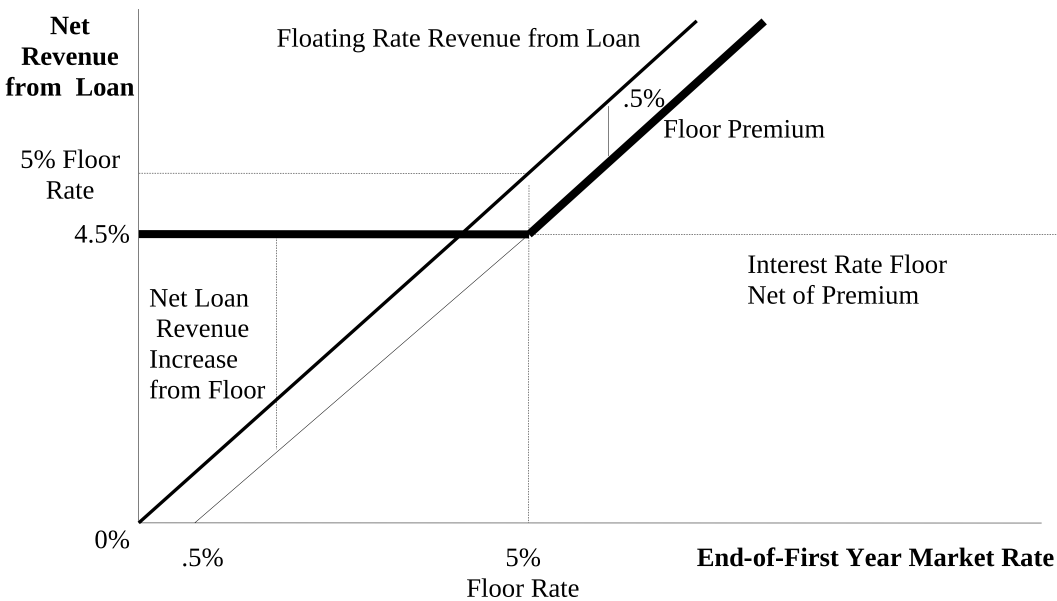


Figure 3: First Year Revenue from Floating Rate Loan and Loan with a Rate Floor

Collars

A collar is essentially the combination of a long position in a cap (a call on the market rate) along with a short position in a floor (a put on the market rate). In effect, the institution implementing the interest rate collar writes or sells a floor on a given interest rate, which requires her to make a payment if interest rates drop below the floor rate. The premium proceeds, which are positive to the floor writer, from the floor sale are used to finance the purchase of a call on the relevant market interest rate. Should the market interest rate increase above the rate of the cap, the cap owner will have the option to purchase the underlying instrument (take a payment) at the exercise price (essentially, the market rate minus the cap rate). No payment is associated with the floor. However, if the market rate drops below the collared rate, the floor writer would make a payment to the floor purchaser.

Suppose, for example, that a bank enters a two-year collar agreement with its client. The collar agreement has a notional value of $1 million at a rate of 5% with payments settled once a year based on year-end interest rates. The bank is short on the collar (short on the cap, long on the floor); the client has a long position on the collar (long on the cap and short on the floor). If the relevant market rate were to drop to 4% at the end of the first year and 3% at the end of the second year, the bank would receive from its client $10,000 = ((5% -4%)×$1,000,000) at the end of the first year and $20,000 = ((5% - 3%)×$1,000,000) at the end of the second year. If the relevant interest rate were to rise to 6% at the end of the first year and 7% at the end of the second year, the bank would owe its client $10,000 = ((6% -5%)×$1,000,000) at the end of the first year and $20,000 = ((7% - 5%)×$1,000,000) at the end of the second year. Essentially, the collar locks interest paid by its client on a variable rate loan at a fixed rate of 5%. See Figure 6.4 for the collared loan payoff structure. We assume here that the cap premium paid by the client and the floor premium paid by the bank offset each other. A collar can have one or more than one exercise dates.

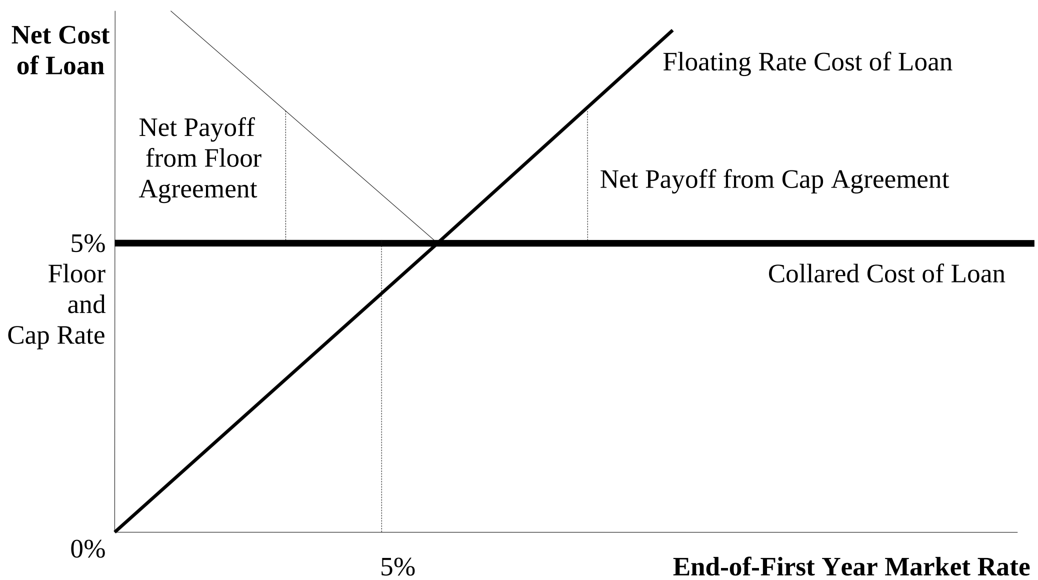


Figure 4: First Year Cost of Floating Rate and Collared Loans

C. ADRs

American Depository Receipts (ADRs) are shares issued by banks evidencing ownership of shares of foreign company stock. ADRs are the American version of a more general security known as an IDR, International Depository Receipt. Many ADRs are traded over the counter, but some meeting various regulatory and reporting requirements are exchange listed. Among the ADRs listed on the NYSE are Telefonos de Mexico, Glaxo, British Telecom and Royal Dutch, all of which are among the most active on the exchange.

Sponsored ADRs are those creation has been facilitated by the underlying company. Sometimes, these ADRs are referred to as ADS, or American Depository Shares. Foreign companies may wish to cross-list their securities in the U.S. to create a broader secondary market and improve liquidity for existing shares, particularly for American investors. ADRs may also increase visibility among the company's customers, suppliers and creditors.

D. Hybrids

Hybrids are financial instruments that contain features of two or more distinct financial instruments. Usually, a hybrid can be synthesized with a portfolio combining two or more positions in other securities.

Warrants

A *warrant* is an option, usually, but not always a call issued by a corporation on its own treasury stock. Warrants provide their owners the right to purchase shares of stock directly from the corporation at a specified exercise price. Warrants are often traded among investors and are often issued by the corporation along with other securities such as bonds or preferred stock. The warrants may be intended by the issuing corporation as inducements to encourage investors to purchase other securities with which they are issued. Other warrants may be issued to managers, employees or investment banks as compensation for services rendered.

Warrants are usually of long duration, in some cases, perpetual. They are often issued with privately placed bonds (in this case, known as an equity kicker). In most instances, they are detachable from the securities with which they are issued. The warrants may be intended by the issuing corporation as inducements to encourage investors to purchase other securities with which they are issued. For example, warrants may be issued with an IPO for a very speculative issue or as financing for a merger (example: old share of common is exchanged for a bond and a warrant).

An important difference between call options and warrants on stock is that warrants are issued on treasury stock rather than outstanding shares. Warrant exercise causes more of the company's shares to be outstanding. Thus, exercise of warrants implies a dilution of share prices, though the corporation does receive exercise money from the exercise of options. However, stock prices may normally be expected to decline as a result of warrant exercise because exercise takes place only if the exercise money paid by investors is less than the value of shares that warrant-holders receive. Accounting for both the additional shares outstanding and exercise money received from warrant exercise, the post-exercise value of the stock S_x can be expressed as follows:

$$w_0 = \frac{c_0}{1+q}$$

where S_0 is the stock value had no warrants been issued, q is the number of warrants exercised per outstanding share and X is the exercise price associated with warrants. If the value of a call c_0 on outstanding shares is known, its relationship to the value of a warrant w_0 on treasury stock is given as follows:

$$S_x = \frac{S_0 + qX}{1+q}$$

Hence, to value a warrant, one may first value a call with the same terms (say, with the Black-Scholes or other appropriate option pricing model) and then adjust the call value for dilution using the equation above.

Convertible and Callable Bonds

Corporations also issue bonds with option like features. For example, a *convertible bond* permits its owner the option to convert the debt security into a specified number of shares of common stock. A convertible bond is, in many respects, similar to a package consisting of a bond and a series of warrants on the firm's stock. One should note that exercise of the convertibility feature does not result in a cash flow to the firm; it results in a reduction in debt. Convertible bond holders may benefit from increases in stock price.

A *callable bond* permits the issuing corporation to repurchase its debt at a later date; in this case, the corporation maintains a call option on the debt securities which it has issued. Firms issuing callable bonds retain the right to "call back" the bonds after the call date and at a premium (an additional sum over the bond's face value) as specified in the bond contract. Firms often issue callable bonds when interest rates are high, giving them the opportunity to refinance when interest rates decline. Convertible and callable bonds are often referred to as hybrid securities because each, in effect, represents the sum of two different securities.

The majority of convertible bonds are callable. Firms often prefer not to face the threat of having stock earnings diluted; thus, they often add a call feature, where conversion can be forced if the stock price is sufficiently high. Few of these callable bonds are redeemed, rather their conversion is usually forced. Convertible bonds (as well as warrants) must be reported on balance sheets on a fully diluted earnings basis.

The example in Table 1 defines a number of terms frequently used in the description of convertible bonds:

Conversion Ratio (CR): the number of shares received per bond. IBM: 6.51, Bally: 30.60
Conversion Value: The value of the shares if converted
Conversion Value = Share Price ≅ Conversion Ratio. IBM: $726.68 = $111.63 ≅ 6.51
Conversion Parity Price (CPP): Break-even Price
Conversion Parity Price = Bond Price / Conversion Ratio. IBM: $156.49 = $1018.75 / 6.51
Conversion Premium = [CPP - Stock Price]/Stock Price; IBM: 40.2%=[$156.49-$111.63]/$111.63
Conversion Premium: Difference between the conversion parity price and stock price as a percentage of the stock price

Convertible Bond Data
Source: *Standard & Poor's Bond Guide*

Issuer	IBM	Bally
Coupon Rate	7.875%	10.00%
Maturity Date	2004	2006
Debt Rating	AAA	D
Conversion Ratio	6.51	30.60
Bond Price	$1018.75	$292.50
Stock Price	$111.63	$4.75
Parity Price	$156.49	$9.56
Conversion Premium	40.2%	101.2%
Conversion Value	$726.68	$145.35

Table 1: Convertible Bond Example

Now, consider an example where the Bios Co. has issued a 6 percent convertible bond (CV) that matures in 20 years. If Bios were to sell a straight 20-year issue in the current market, the bond would have to yield eight percent to be competitive. What would be the price of a 20-year straight bond with a six- percent coupon rate if the investor required an eight- percent YTM? This is determined as follows:

$$V_{SD} = \frac{60}{.08}[1 - \frac{1}{(1+.08)^{20}}] = \$803.63$$

The straight bond would sell for $803.63. Thus, if a CV had a face value of $1000 that pays the same interest, the warrant part of the CV would be worth 1000 - 803.63=196.37. Similarly, the value of the option feature of the convertible bond could be determined with an appropriate option pricing model.

We will verify this option feature valuation of $196.37 by considering some equity and bond features. Suppose that the stock is currently selling for $40 per share and the conversion ratio is 10 (the bond can be converted for 10 shares of stock). Further suppose that there are 1,000,000 shares of stock currently outstanding and 10,000 convertible bonds. The riskless return rate equals the bond's yield to maturity of .08 and the standard deviation of stock returns equal .1606.

First, we will compute the conversion option as though it were calls on 10 shares of stock:

$d_1 = \{ln(400/803.63) + (.08 + .5\cong.0258)\cong 20\} \div \{.1606 * \%20\} = 1.311$
$d_2 = d_1 - .1606*\%20 = .59283$

Next, by either using a Z-table or by using an appropriate polynomial estimating function from a statistics manual, we find normal density functions for d_1 and d_2:
$N(d_1) = .90508$; $N(d_2) = .723353$

Finally, we use $N(d_1)$ and $N(d_1)$ in Equation (8) to value the call on 10 shares of stock:

$c_0 = 400(.90508) - [803.63 \cong .201897]\cong(.723353) = 215.9898$

Next, we value a warrant to account for q, the dilution caused by the conversion of bonds. Since there are 10,000 convertible bonds and 1,000,000 shares of stock, conversion will increase the number of outstanding shares by q = .1 or 10%. Hence, we divide the call value or $216 by (1+q) = (1 + .1) to obtain the warrant value of $196.37 as determined earlier. Thus, the overall value of the bond equals the sum of its straight debt value and its option value:

$$V_{CB} = V_{SD} + V_O = \$803.63 + \$196.37$$

When to Convert

Consider the following example concerning convertible bonds. The Budge Company issued 2500 convertible bonds with $1000 par value, in December 1992. Each bond is convertible into 100 shares of Budge common stock on the maturity date, December 2008. Budge currently has 1 million shares of common stock outstanding. If at maturity the bondholders will receive $1000 in principle plus $100 in interest if they do not convert. How much must the total assets of the firm be worth to make conversion worthwhile for the bondholders?

When the Value of receiving principal and interest is equal to the value of converting into stock, the investor should be indifferent. The, we calculate the value of receiving principal and interest:

# of conv bonds * (principal + interest): 2500 * (1000 + 100) = 2,750,000

The value of converting into stock at maturity is equal to the proportional value of assets that will be owned if the bond is converted times the overall value of assets:

$$\text{conv. Value} = \frac{(\text{shs./bond})*(\#\text{bonds})*\text{Asset Value}}{(\text{shs./bond})*(\#\text{bonds}) + \text{Current shs.}}$$

Finally, solve for indifference Value of Assets, when conversion value is 2,750,000,

$$2{,}750{,}000 = \frac{(100) \times (2{,}500) \times \text{Asset Value}}{(100) \times (2.500) + 1{,}000{,}000}$$

Thus, Asset Value is 13,750,000. So if Budge's Value of Assets exceeds 13,750,000, the bonds should be converted.

Let us consider why this set of equations works. First, we will make a minor algebraic change to this equation to explain it in other terms. We will divide both sides by (100)*(2500):

$$\frac{2{,}750{,}000}{(100) \times (2{,}500)} = \frac{\text{AssetValue}}{(100) \times (2.500) + 1{,}000{,}000}$$

The change to the equation is minor, but its interpretation is different. On the left hand side, we have the total maturity value of bonds on a per share basis. This reflects what the investor gives up per share of stock to convert his debt. On the right-hand side, we have firm asset value, on a per share basis, that the investor would receive. Thus, from the left side, we have what the investor gives up per share by converting. On the right side, we have what the investor gets, per share, by converting. Asset value would have to be sufficiently high to justify converting.

Why Use Warrants or Convertibles?

The following list outlines why firms might prefer to issues warrants or convertibles rather than straight debt:

- Interest rates on new debt issues may be unfavorable. As an incentive to purchase bonds at a lower interest rate, potential investors may be offered warrants or convertibles

- Match cash flows: low interest rates when a firm is young and growing, bonds are converted later causing dilution when it isn't as expensive.
- Protection against the inability to access risk. If a company is riskier than expected the option portion will have high value and the bond lower value. If the company turns out to have low risk the bond portion will have high value and the option will have low value.
- The current stock price may be low, making a common stock issue undesirable.
- The firm may need cash generated by warrants at a future date.
- Reduces potential agency costs between debtholders and equity holders due to risk. shifting. If the stockholders unexpectedly take on risky projects, the option portion of the convertible bond protects the convertible bondholder.

Differences between Debt with Warrants and Convertibles

First, consider that the terms of the instruments may be set so as to make the instruments identical to one another. That is, assume that the conversion ratio for the convertible bond equals the number of warrants that might otherwise be issued with straight debt. One is not clearly superior to the other; the situation faced by the firm and investors will impact the desirability of one or the other. First, warrants are exercised for cash, meaning that the first receives cash when warrants are exercised. Thus, warrants represent a potential source of cash to the firm. Convertibility provisions of convertible debt are exercised by retiring or reducing the firm's level of debt. In addition, if warrants are ultimately not exercised, tax authorities might regard the initial value of those warrants as taxable income to the firm. This taxability does not normally apply to convertible bonds.

The bond and warrant combination can offer some advantages if it can attract two distinct groups of investors: (1) those who want straight high-yield debt and (2) those who want warrants or an equity kicker in the firm. However, this is an advantage only when the issue is large enough to provide sufficient liquidity for all three instruments. On the other hand, the issuing costs are higher for the detachable warrant units because of the complexity that they add to the issue. Also, if warrants are detached from the bonds with which they are issued, this will imply that the debt is sold at a discount, "original issue discount" (OID). As we discussed above, the instruments are treated differently for tax purposes. Finally, warrants are exercised for cash while convertibility provisions are exercised for reductions in debt. Some of the consequences to firms for this are obvious.

E. Index Contracts

Stock indices exist to permit simple evaluations of market performance. Broad market indices such as the S&P 500 and the Wilshire 5000 index exist to indicate overall market performance. An index future is a contract on an index. For example, the S&P 100 index has associated with it a futures contract (the OEX) which is traded on the Chicago Mercantile Exchange (CME). The Chicago Board of Trade markets the Major Market Index contract on the 20 largest NYSE stocks. The contract value equals the index value times a constant known as the *futures value multiplier*. In the case of each of these two contracts, the futures value multiplier equals $500.

Specific industry or segment indices exist to indicate performance in a narrow market. Stock index futures contracts exist to permit investors to take positions in a particular market without having to take positions in each of the component securities. Among the well-known index futures contracts are or have been the VLCI on traded on the Kansas City Board of Trade until 2012, the S&P 500 on the Cboe Globex system, MMI on Chicago Board of Trade, and the NYSE on the New York Stock Exchange.

Index Options

Options on these futures contracts trade on exchanges as well. Among the well-known options contracts on stock indices are or have been the Value Line Composite Index (VLCI) on the Philadelphia Exchange (PHLX), OEX (S&P 100) on the Chicago Board Options Exchange (CBOE), and the NYSE on NYSE. The two primary purposes of Index Options are:

1. for speculating on 1 option rather than series of contracts
2. for hedging the risk of a portfolio whose construction resembles that of the index.

Index Construction

Traders wishing to take positions in the stock market of a particular country without committing to a single company's stock may take a position in an index futures contract or in options on that contract. For example, the Osaka Stock Exchange trades options contracts on the Nikkei 225, which is an unweighted index of the shares of the 225 largest companies traded on the Tokyo Stock Exchange. Futures index contracts exist for most major country markets. Among these indices for markets outside of the U.S. include the FTSE 100 (the *"Footsie 100" or Financial Times - Stock Exchange 100*) in the U.K., the DAX (*Deutscher Aktienindex*, based on 30 equities), the CAC 40 (*Cotation Assistée en Continu*), the TSE 300 on Toronto and the SPI (Swiss Performance Index on approximately 400 firms). A "composite" international index computed by Morgan Stanley is the *EAFE* (Morgan Stanley Capital International Europe, Australia, Far East Index) based on approximately 2000 companies in 21 countries. Among the important index option contract features are:

1. Contract multiple: number of options in contract
2. Cash settlement
3. End of day exercise only
4. Regular expiration cycles
5. Taxes: all realized and unrealized gains are taxable

There are three primary methods for weighting the various securities comprising a particular index:

1. Price Weighted: $I_{pt} = [\Sigma_{i=1}P_{it}/n]$; Example:
   $DJIA_t = [\Sigma_i P_{it}/AD_t]$ where AD_t is adjusted divisor
   $MMI_t = [\Sigma_i P_{it}/AD_t]$
2. Value Weighted: $I_{vt} = [\Sigma_{i=1}Q_{it}P_{it}] \div [\Sigma_{=1}Q_{i0}P_{i0}]$; Example:
   $SP500_t = [\Sigma_i Q_{it}P_{it}] \div [\Sigma_i Q_{i0}P_{i0}] * 10$
3. Equal Weighted: $I_{et} = [\Sigma_{i=1}P_{it}/P_{i0}]$

Another type of index option, the Market Volatility Index (MVI) traded on the CBOE is used by investors to take positions on the volatility of the market. This index is based on the implied volatilities of options on the S&P 100 (OEX). These options are particularly useful to investors who wish to hold vega neutral portfolios (portfolios whose values are invariant with respect to the risk of component securities).

A number of empirical studies have been conducted on various types of index contracts and their pricing. For example, Evnine and Rudd [1985] found a significant number of arbitrage opportunities based on the binomial option pricing model for 1798 SP100 and MMI option transactions between June 26, 1984 and August 30, 1984. However, many of these apparent arbitrage opportunities may not really have existed because of the inability to trade underlying assets or because of the high level of activity at that time. Also, the binomial model requires restrictive assumptions and option trades were not simultaneous.

<u>Portfolio Insurance and Program Trading</u>

Index futures and options are often used for portfolio insurance, an asset allocation strategy enabling investors to alter their portfolio risk structure. Usually, it is intended to limit downside portfolio risk. An insured portfolio is one whose loss is limited to a known finite level while its return is a predictable function of the return of the underlying uninsured portfolio.

The following are definitions of terms often used in conjunction with portfolio insurance:

1. Floor: minimum portfolio value
2. Cushion: difference between portfolio value and floor
3. Exposure: potential loss
4. Multiple: exposure ÷ cushion
5. Hedge Ratio: total face value of contracts ÷ portfolio face value

Managers may wish to rebalance a portfolio to maintain a constant multiple. The objective of each of the following portfolio management strategies is to maintain upward stock price potential while eliminating downside risk below a floor:

1. Stop-loss order: its disadvantages are that it does not allow for upward profit potential after the sell order is executed; this strategy is *path dependent* in that its success is a function of market movement. Also, it does not guarantee execution at the floor value.
2. Purchase put options: Buy appropriate equity or index puts. This presents a *tracking problem* in that the correlation between the portfolio and the index may not be perfect. Imperfect correlation leads to finding appropriate hedge ratios. Also, most traded options are of the American variety, thus, are more expensive to purchase. Also, short term standard expirations and the small number of exercise prices limit the applicability of these contracts. However, if the correlation between the index and portfolio is perfect, the advantage of this strategy is that it does not require continuous rebalancing.
3. Create synthetic puts: One can create synthetic puts by continuously updating hedge ratios in the Black-Scholes framework. This process is analogous to the process of creating a synthetic call by buying stock and borrowing money in the binomial or Black - Scholes frameworks (Note: the hedge ratio must be continuously updated). To create a synthetic put, one sells stock and lends. Again, the hedge ratio is continuously updated in the Black - Scholes framework. The hedge ratio for the number of shares to sell is given:

$$1-\frac{dp}{dS}=1-e^{-rt}N\left(d_1\right)=1-\frac{\left\{\ln\left(\frac{S}{X}\right)+\left(r_f+.5\alpha^2\right)t\right\}}{\sigma\sqrt{t}}$$

where X is the terminal floor value of the portfolio and S is the current market value of the stocks. The selected put is on the index which most resembles the portfolio. This strategy is likely to present several difficulties:

a. It is likely to involve frequent trading
b. There may be restrictions on selling and borrowing.
c. Stock prices do not follow an Itô process.
d. There may be uncertainty regarding future interest rates, volatilities or dividends.

4. Dynamic hedging using futures contracts involves the shorting of index futures, updating as required. The dynamic hedge ratio is the number of contracts to short:

$$n_f=\left\{\left[\frac{V}{(S+p)}\right]\left[1+e^{-rt}\left(N\left(d_1\right)-1\right)\right]-\frac{V}{S}\right\}e^{-rt}$$

where p is the value of a put with an exercise price of S. Dynamic hedging has the advantage of relatively liquid futures contracts and allows for frequent updating with fairly low transactions costs. However, it still requires perfect correlation between the portfolio and the index. The major problem associated with dynamic hedging is the inability to trade instantaneously, causing the hedge to work less than perfectly and limiting upward portfolio value potential.

F. Volatility Index Contracts

The Black-Scholes and other option pricing models typically assume that underlying security volatility is constant over time, leaving investors exposed to the reality of uncertain changes in volatility. Market volatility and sentiment does shift over time, often unpredictably, creating the potential for risk-based contracts to successfully trade. The *Volatility Index*, also known by contracts trading under the symbol *VIX*, or popularly known as the fear index, was developed by Robert Whaley for the CBOE in 1993, arising from a proposal by Brenner and Galai [1989], motivated, in part, by the stock market crash of 1987. The VIX is often interpreted to be the volatility of the S&P 500 expected by the market over the next 30 days.

The CBOE Volatility Index, a benchmark designed to gauge S&P 500 or stock market volatility, was created to track the volatility implied by market prices of option contracts written on S&P 500 contracts. The index is created from a series of volatilities of near-the-money contracts with an average maturity of approximately 30 days constructed from options with expirations between 23 and 37 days out. Thus, the VIX is calculated using real time prices of S&P 500 options, and is reported as a percentage, just as standard deviation might be reported as a percentage (e.g., 20%). VIX might be interpreted as a crowd-sourced estimate of market risk.

The VIX, or index itself is based on market prices of contracts traded on S&P 500 options contracts. The volatility index is only an index; it is not directly traded. However, numerous contracts, including futures and options contracts (such as contracts using the market symbol VIX) are traded with the volatility index as a basis for calculation. VIX calculations are summarized in Appendix B to this chapter; detailed calculation instructions are provided in CBOE [2009].

In addition to the VIX series, the CBOE also trades a variety of index contracts that concern volatilities over different periods. For example, VIX9D series is based on contracts that bracket 9 days rather than 30 days. The Cboe DJIA Volatility Index (VXD) series is similar to the VIX series except that it is based on estimates of the expected 30-day volatility of DJIA (Dow Jones Industrial Average) index returns. Other volatility indices include the NASDAQ Market Volatility Index (VXN) and the BuyWrite Monthly Index (BXM), which is based on portfolios consisting of long positions in the S&P 500 index along with covered short positions on calls. Cboe volatility index contracts are traded on a variety of other markets such as the CBOE Crude Oil Volatility Index (OVX), the CBOE Gold Volatility Index (GVZ) and the CBOE EuroCurrency Volatility Index (EVZ).

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Exercises

1. What is the key activity in the creation of asset tranches that enables mortgage securities of distinct risk classes to be created from a single mortgage pool?

2. The following are concerned with managing risks associated with the Secured Overnight Financing Rate (SOFR):

   a. Suppose that a bank enters into a one-year total return swap in which its client pays the Secured Overnight Financing Rate (SOFR) on the notional amount of $5,000,000 in exchange for a fixed rate of 4%. Suppose that after one year the SOFR is 5%. What payments follow at the end of the year between the bank and its client?

   b. Following part a, suppose instead a bank's client borrows $5,000,000 for one year at a variable rate. The bank enters a one-year cap agreement with this client in which the bank accepts a premium of 0.6% on the notional amount ($5,000,000). Assume that the agreement is for a cap rate of 4% with payments settled at year-end based on year-end interest rates. Suppose that after one year the market rate is 5%. What is the premium payment on the cap agreement? What payments follow at the end of the year between the bank and its client on the cap agreement? What interest payment does the client make on its loan?

   c. Continue to follow part a, where the bank's client borrows $5,000,000 for one year at a variable rate, but ignore part b. The bank enters a one-year floor agreement with this client in which the bank pays a premium of 0.6% on the notional amount ($5,000,000). Assume that the agreement is for a floor of 4% with payments settled at year-end based on year-end interest rates. Suppose that after one year the market rate is 5%. What is the premium payment on the floor agreement? What payments follow at the end of the year between the bank and its client on the floor agreement? What interest payment does the client make on its loan?

   d. Continue to follow part a, where the bank's client borrows $5,000,000 for one year at a variable rate. The bank enters a one-year collar agreement with this client in which no premium is paid, leaving the client long on the cap and short on the floor, both at a rate of 4%, settled at year-end based on year-end interest rates. Suppose that after one year the market rate is 5%. What payments follow at the end of the year between the bank and its client based on the collar agreement? What interest payment does the client make on its loan?

3. Equity swaps have been used by investors to reduce their risk in an equity investment without actually selling shares. For example, corporate managers have used the *executive equity swap* to reduce their personal exposure in their shares of their employers' stock. In a well-publicized case involving Autotote Company, at the time, a NASDAQ listed manufacturer of wagering equipment, the CEO Lorne Weil arranged a swap contract through Bankers Trust (since taken over by Deutschebank) to deliver dividends and any capital gains (which would be negative in the event of a capital loss) associated with Autotote stock in exchange for cash flows associated pegged to the variable interest rate LIOBR. How might Mr. Weil have benefitted from this transaction?

4. The Franklin Company issued 5000 convertible bonds with $1000 par value, in December 1997. Each bond is convertible into 200 shares of Franklin common stock on the maturity date, December 2008. Budge currently has 1 million shares of common stock outstanding. If at maturity the bondholders will receive $1000 in principal plus $80 in interest if they do not convert. How much must the total assets of the firm be worth in December 2008 to make conversion worthwhile for the bondholders?

Solutions

1. Prioritization of payments to the different tranches is the key to creating distinct multiple risk classes associated with a pool of mortgages. Enhancing the credit of one tranche improves it relative to other tranches. This is accomplished through prioritization or the attachment of appropriate credit derivatives

2. a. The payment is netted at the end of the swap term with the client making a payment of \$50,000 = (\$5,000,000 × (5% - 4%).
   b. The beginning-of-year fixed payment or premium from the client to the bank is \$30,000 = \$1,000,000 × 0.6%. The end-of-year payment from the bank to the client is \$50,000 = (\$5,000,000 × (5% - 4%). The interest payment made by the client on its loan is \$250,000 = \$5,000,000 × 5%, or \$200,000 net of the cap payment by the bank: (\$250,000 - \$50,000), or \$220,000 net of both the cap payment by the bank and the cap premium paid by the client.
   c. The beginning-of-year fixed payment or premium from the bank to the client is \$30,000 = \$1,000,000 × 0.6%. The end-of-year payment from the client to the bank is zero because the market rate exceeded the floor rate. The interest payment made by the client on its loan is simply \$250,000, or \$220,000 net of the floor premium received by the client.
   d. The beginning-of-year fixed payment or premium from the bank to the client is zero because the floor payment offsets the cap payment. The end-of-year payment from the client to the bank is zero because the market rate exceeded the floor rate. The end-of-year payment from the bank to the client is \$50,000 = (\$5,000,000 × (5% - 4%) because the market rate exceeded the collared rate. The interest payment made by the client on its loan is \$250,000 = \$5,000,000 × 5%, or \$200,000 net of the cap payment by the bank: (\$250,000 - \$50,000).

3. Technically, the CEO did not sell his shares, though he divested himself of the return risk associated with share ownership. By engaging this equity swap, the CEO reduced his risk in his employing company without having to report a sale of shares (though, Weil did voluntarily report this transaction, and the SEC now does require such reporting). This meant that the CEO was not subject to capital gains taxes at the time of the transaction (though, this tax benefit has since been eliminated by the IRS. The CEO is not likely to bear the selling price consequences associated with an insider sell transaction. Furthermore, the CEO maintained his level of voting control in the company's shares since he still owned them. Thus, in a sense, the equity swap permitted the CEO the opportunity to, in effect, execute a sale of shares without bearing most of the undesirable consequences associated with the sale.

4. The value of receiving principal and interest on the bond equals:

#of conv bonds * (principal + interest) = 5000 * (1000 + 80) = 5,400,000.

The value of converting into stock equals the proportion of assets owned if bonds are converted × Value of Assets:

$$\frac{\text{(shs./bond)*(\#bonds)*Asset Value}}{\text{conv. Value}} = \text{(shs./bond)}\times\text{(\#bonds) + Current shs.}$$

.
Now, solve for the indifference Value of Assets when the bonds' conversion value is 5,400,000:

$$5{,}400{,}000 = \frac{(200)*(5000)*\text{Asset Value}}{(200)*(5000) + 1{,}000{,}000}$$

Thus, Asset Value is 10,800,000. So if Franklin's Value of Assets is more than 10,800,000, the bonds should be converted.

Appendix 13: The VIX Calculation

THE VIX CALCULATION STEP-BY-STEP

Stock indexes, such as the S&P 500, are calculated using the prices of their component stocks. Each index employs rules that govern the selection of component securities and a formula to calculate index values.

VIX is a volatility index comprised of *options* rather than stocks, with the price of each option reflecting the market's expectation of future volatility. Like conventional indexes, VIX employs rules for selecting component options and a formula to calculate index values.

The generalized formula used in the VIX calculation[§] is:

$$\sigma^2 = \frac{2}{T}\sum_i \frac{\Delta K_i}{K_i^2} e^{RT} Q(K_i) - \frac{1}{T}\left[\frac{F}{K_0} - 1\right]^2 \qquad \textbf{(1)}$$

WHERE...

σ is	$VIX/100 \Rightarrow \text{VIX} = \sigma \times 100$
T	Time to expiration
F	Forward index level derived from index option prices
K_0	First strike below the forward index level, F
K_i	Strike price of i^{th} out-of-the-money option; a call if $K_i > K_0$ and a put if $K_i < K_0$; both put and call if $K_i = K_0$.
ΔK_i	Interval between strike prices – half the difference between the strike on either side of K_i: $\Delta K_i = \frac{K_{i+1} - K_{i-1}}{2}$ (*Note*: ΔK for the lowest strike is simply the difference between the lowest strike and the next higher strike. Likewise, ΔK for the highest strike is the difference between the highest strike and the next lower strike.)
R	Risk-free interest rate to expiration
$Q(K_i)$	The midpoint of the bid-ask spread for each option with strike K_i.

Image copied from CBOE [2009], accessed 2020/12/28 from https://www.optionseducation.org/referencelibrary/white-papers/page-assets/vixwhite.aspx.