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INTRODUCTION AND OVERVIEW OF RETIREMENT PLAN INVESTMENTS

by

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Introduction and Overview of Retirement Plan Investments

A key component to the overall operation of most retirement plans is the accumulation and holding of plan assets in order to meet the financial commitments of the plan. There are some plans, particularly executive benefit plans, under which no assets accumulate. Such plans are the exception rather than the rule, however, and a thorough understanding of various funding instruments, as well as the nature of the underlying financial assets is essential. With such knowledge, it then becomes possible to choose assets and asset allocations appropriate to plan liabilities, select and apply appropriate asset valuation methods, match plan assets and liabilities, etc. In short, a working knowledge of assets and funding instruments is required in order to utilize the actuarial techniques needed to manage any retirement program.

Responsibility for oversight of retirement plan investments

With any type of retirement plan, the employer/plan sponsor retains some degree of responsibility for the selection and management of retirement plan assets. The amount of responsibility will vary, depending on the type of plan. With a defined benefit plan, the employer bears the full investment risk since variations in investment returns will impact the level of required employer contributions. Under defined benefit plans, no direct investment responsibility lies with employees, since ultimate benefits are unaffected by investment performance.

In defined contribution plans, the level of employer responsibility can vary. In the years immediately subsequent to ERISA, most defined contribution plans did not offer employees a choice of investments. All such decisions were made by the employer sponsor. In defined contribution plans where employees have no control over how their plan accounts are invested, the employer bears full responsibility for investment decisions. While employer contributions are unaffected by investment results, an employee's ultimate benefit under a defined contribution plan is very much dependent on investment performance. Employers will be the first to know if investment performance is not meeting employee expectations. Although quite rare, some defined contributions plans continue to exist where all investment decisions are made by the plan sponsor.

Far more prevalent, however, are the situations where employees are given full opportunity to direct their investments. In defined contribution plans where employees are offered a choice of funds in which to invest, the employer still bears some investment responsibility. Generally, the employer is responsible for selecting the menu of investment funds from which employees can choose. It is incumbent on the employer to keep a fund line-up that is both diverse and competitive. Also, the employer will make decisions regarding both plan design and plan administration that can indirectly affect investment performance. Examples of this include decisions as to whether to "auto-enroll" employees, default investment elections, whether to engage vendors that provide investment education and advice to plan participants, how/if expenses of plan administration will be shared with employees, etc.

When employees bear the ultimate investment risk under a defined contribution plan, they must accept investment responsibility in situations where they exercise control over investment selection. At the very least, employees need to understand the various types of available investments in order to make informed investment decisions. With the prevalence of retirement programs now being employee-directed defined contribution plans, the need to assist employees in their efforts to make informed, appropriate investment decisions is of prime importance. Obviously, not all employees are well-prepared for this responsibility, and furthermore do not take responsibility for the continuing need to monitor and adjust as needed. One common method employed to assist employees in this regard is through the provision of an investment lineup that includes so-called "Lifestyle Funds" or "Target Date Funds." This style of funds offers the employee the opportunity to invest in a vehicle that reflects such personal choices as their investment risk tolerance or their target retirement date. If an employee chooses to utilize these funds, they create a risk profile or projected retirement timeframe (Target Date), and their plan account is invested under a pre-determined investment offering that has been designed by investment professionals to fit their profile. Lifecycle Funds have an asset allocation based on the employee's risk tolerance. Aggressive funds are designed primarily for younger employees and conservative funds are designed primarily for older employees. It is up to the employee to change the Funds. If an employee elects Target Date Funds, then as the employee ages and nears the target date, typically retirement, the asset allocation underlying the offering is automatically changed appropriately reducing the risk without any action required by the employee.

An employer will frequently enlist the assistance of other professionals in the oversight of plan assets. With any plan, an employer may hire a professional investment manager to take responsibility for the management and selection of plan assets. The investment manager will normally have some general guidelines that have been established by the plan sponsor, i.e. liquidity requirements, risk tolerances, asset allocation preferences, etc., and will manage plan assets accordingly. The investment manager "reports" to the employer/plan sponsor and will make periodic reports of performance. It is not uncommon for sponsor's to employ several investment managers, particularly if the sponsor wants to take advantage of different investment styles and individual areas of expertise.

It is also quite common for plan sponsors to periodically retain independent investment consultants to review and comment on all aspects of the investment "model" utilized for their retirement program. Investment consultants provide assistance in establishing overall investment policies, writing investment policy statements, benchmarking investment results, ensuring that all appropriate asset classes are represented and ensuring that plan fiduciaries are acting appropriately in the discharge of their duties. The importance of undertaking such an independent periodic review has grown steadily over the years, particularly as the shift from a predominance of employer-controlled defined benefit plans to employee-controlled defined contribution plans has occurred.

A plan sponsor may also retain the services of an asset custodian or trustee to perform certain administrative functions associated with plan assets. These professionals are responsible for assembling the data needed to report financial results for all managers on a consistent basis. They may also be responsible for making benefit disbursements to plan beneficiaries, tax

reporting and other plan administrative functions. The level of investment responsibility of these professionals can vary, and is usually defined in the written service contract between the provider and the plan sponsor. When a professional trustee is used, there is usually some acceptance of investment responsibility on the part of the trustee. A trustee is responsible for ensuring that plan investments are "reasonable," but is generally not involved in the selection of specific investments. In the case of an asset custodian, the custodian assumes no investment responsibility and is retained to provide administrative services only.

Types of vehicles available

The vehicles available for the accumulation of the assets that support the benefit commitments under a retirement plan are diverse. When "pre-funded" retirement programs first came into being, most plans were funded using products issued by life insurance companies. There are still many products designed for this purpose, namely Group Annuity Contracts, Individual Annuities, Deposit Administration (DA) Contracts, Immediate Participation Guarantee (IPG) Contracts and even Life Insurance Contracts. Under these insured funding arrangements, plan sponsors pay premiums or make plan deposits to the insurer in order to accumulate plan assets. In return, the insurer makes certain guarantees that vary according to the type of contract. At one extreme, the individual annuity is an insurance product that charges a premium in exchange for a guaranteed monthly benefit beginning at some future date. Under such a contract, there is no assumption of investment risk by the plan sponsor; such risk is transferred to the insurer, who is compensated through the annuity premium.

Under DA or IPG contracts, the insurer does not assume all of the investment risk. Under these arrangements, employers make contributions and receive investment returns based on the performance of the insurer's general account assets. As employees retire, guaranteed annuity contracts are set up that represent a commitment on the part of the insurer to guarantee the employee's benefit. The rate basis for these annuities is specified in the contract, and the insurer may deduct or "reserve" the amount needed to purchase the annuity from the total DA or IPG fund balance. Under these contracts, the employer is making an investment decision to invest plan assets in the general account assets of the insurance company. These assets will normally represent a portfolio with a high percentage of fixed income investments, i.e. bonds and mortgages, as is required by state insurance regulation. The employer has no involvement with the selection of specific investments or securities for its plan. Under all of these insured vehicles, the insurance company is essentially acting as the investment manager, trustee and custodian of plan assets.

In order to give clients investment opportunities other than their general accounts, insurers have developed "separate accounts." Separate accounts are similar to mutual funds and are not constrained in their investment content as are general accounts. Separate accounts can invest in equities, real estate, foreign securities and virtually any other specialty market that insurers want to offer. A plan sponsor wishing to diversify beyond the general account can take advantage of separate accounts, while staying with one of the insurer's product offerings. As with the general account, the plan sponsor makes the initial to decision to invest with the separate account, but is not involved in making further investment decisions. Each separate account will have a fund manager, who is retained by the insurer/sponsor of the account.

While insured contracts were common with earlier retirement plans, the uninsured contract is the predominate funding vehicle currently. Under an uninsured contract, the employer's investment responsibility is greatly enhanced, since there is no insurer who is being paid to assume such risk. At the same time, the degree of the employer's autonomy and flexibility in making investment decisions can be virtually unlimited, within the boundaries of applicable statutes. Employers are free to pick investment manager(s) and a trustee/custodian, or may choose to assume these roles themselves. Decisions in this area will most likely be made based on the size of the plan assets, costs of hiring outside professionals and desired involvement by the plan sponsor. With this increased responsibility, the plan sponsor must make prudent, thoughtful decisions regarding plan investments. Investment decisions will directly impact the level of participant benefits, employer contributions or both. Consequently, knowledge is required regarding the various classes of investments, the associated risk of each and the appropriateness of each investment as support for the retirement plan benefit commitment.

Objectives of Pension Plan Investing

An investment is an item of monetary value designed to produce income for the owner. The purpose of investments in a pension trust is to meet pension obligations when they become due. In legal terms under ERISA, they are to be “solely in the interest of the participants and beneficiaries and for the exclusive purpose of (i) providing benefits to participants and their beneficiaries; and (ii) defraying reasonable administrative expenses of administering the plan.”¹ These assets should be invested “with the care, skill, prudence, and diligence under the circumstances then prevailing that a prudent man acting in a like capacity and familiar with such matters would use in the conduct of an enterprise of a like character and with like aims; by diversifying the investments of the plan so as to minimize the risk of large losses, unless under the circumstances it is clearly prudent not to do so”.² ERISA was the first major piece of legislation to embrace modern portfolio theory (MPT). Under MPT, trustees are more concerned with the impact of an asset on the portfolio's expected return and risk, than judging each asset solely on its individual merits.

A basic tenet in capital market theory is that all investors want to be on the efficient frontier. The efficient frontier is the set of portfolios where, for any given level of risk, the return is maximized, and for each rate of return, the risk is minimized. From an asset only perspective, risk can be defined as return volatility. From the liability driven investment perspective, risk can be defined as contribution volatility, funding surplus volatility, or probability of avoidance of a large decrease in funded status. An objective of a pension trust is to be on the efficient frontier. Several studies have shown that about 90% of return is due to asset allocation. Discussion of asset allocation and portfolio management, however, is primarily outside the bounds of this study note.

Classes of Investments

At various stages, a government or company may need more capital. A government may obtain additional capital by selling bonds. A company can obtain more capital from borrowing from a bank or some other source, selling bonds, or issuing stock. In exchange for

the use of capital, entities pay a rate of return. Payments for the use of capital form the backbone of investments.

Investments in a pension trust typically include stocks, fixed income securities, cash or cash equivalents, and real estate. Investments may also include private equity, hedge funds, commodities and infrastructure. Fixed income securities include Treasury securities, municipal bonds, corporate bonds, collateralized mortgage obligations and other asset backed securities. These types of assets are discussed below.

Fixed Income Securities

Treasury securities include Treasury bills, notes, and bonds. Treasury bills or “T-bills” are issued by the Federal Reserve Bank with maturity periods of 13, 26, and 52 weeks, with face amounts starting at \$10,000. They are backed by the Federal Reserve and are widely considered to be cash equivalent. The US T-bill market is the largest and most liquid in the world. T-bills are discount securities; i.e., they do not pay coupons. Treasury notes, which have a maturity of from 2 to 10 years, and Treasury bonds, which have a maturity of 20 or 30 years, pay coupons every 6 months. Individual coupon payments and the maturity value for Treasury notes and bonds can be separated and sold separately as zero coupon Treasury STRIPS. This was initiated in the private sector and is now aided by the Treasury department with its Separate Trading of Registered Interest and Principal of Securities (STRIPS) program.

T-bills are considered to be equivalent to cash since they are so liquid. Since they do have a rate of return, they should be held instead of cash whenever possible. Liquidity is needed in pension plans to pay benefits, especially when the cash flow from interest, dividends, and employer contributions will not suffice. This is especially true for plans with lump sum options or other unusual needs.

Municipal bonds are either general obligation bonds or revenue bonds. General obligation bonds are backed by the taxing power of the municipality and revenue bonds are funded by municipal revenue. Sources of municipal revenue include tolls, gas tax, hospital revenue, airport fees, fees for using a sports complex, fees for sewer hookups, fees from public utility, and income from housing projects. Revenue bonds are usually higher rated.

A **corporate bond** is a loan from the purchaser to the company. They are usually issued in denominations of \$1,000. The principal amount or par value is the amount used to determine the interest payment and must be paid at maturity. The legal provisions or contract is called the indenture. This contract will specify how much interest must be paid and when it must be paid. It will also state when the principal must be repaid and what the collateral is, if any. The restrictive clauses in the indenture, designed to protect the buyer of the bonds, comprise the covenant. For example, the covenant may require the borrower to maintain a certain level of working capital or put in restrictions on issuance of new debt or payment of dividends.

Commercial paper is a discount instrument issued by corporations that is similar to T-bills, i.e., the period is a year or less and there are no coupons. The yield for commercial paper is higher than the yield on T-bills due to credit risk, lack of liquidity, and taxes. The interest on

T-bills is exempt from state and local income tax but the interest on commercial paper is subject to tax.

Bonds are rated by Moody's Investor Service, Standard and Poor's Corporation, Fitch Investors Service, and Duff & Phelps/MCM Investment Research Company. The ratings range from Aaa to C, AAA to D, AAA to D, and AAA to CCC, respectively. The higher the rating, the lower the risk of default and the lower the yield. The difference in yield between AAA and BB, for example, is referred to as the yield spread.

Bonds with assets as collateral, issued by blue chip companies, have the least risk or highest rating. These bonds will have the lowest yield. If the bond is unsecured, then it is a debenture. These bonds will have a slightly lower rating and higher yield to compensate the owner for higher risk. The next lower bond in the hierarchy is the subordinated debenture.

Some bonds are issued with a call feature. This permits the issuer to "call" or repurchase the bond at a specified price prior to maturity. This is comparable to the bondholder selling a call option to the bond issuer at time of purchase. This means that a callable bond will be worth less than a non-callable bond. A call option will limit the appreciation when interest rates decline to the specified price that the issuer will pay. It also exposes the bondholder to reinvestment risk since bonds will not be called unless interest rates are low enough for the bond issuer to refinance at a lower rate. Bonds may be issued with call protection which prohibits the issuer from calling the bond during the first specified years after issue.

A **mortgage pass-through security** represents a pool of mortgages sold as shares. The owner of the shares will receive a pro rata portion of the interest and principal each month minus service fees. Pass-throughs issued by the Federal National Mortgage Association (Fannie Mae) and Federal Home Loan Mortgage Corporation (Freddie Mac) are guaranteed by the agency and those issued by the Government National Mortgage Association (Ginnie Mae) are guaranteed by the federal government. Private label pass-throughs are registered with the SEC and are rated on a basis comparable to bonds. The underlying securities can be based on fixed or adjustable rate mortgages, balloon mortgages, or graduated payment mortgages.

The total cash flow from the mortgages will depend on the prepayment rate. Prepayments occur when properties are sold, refinanced due to a reduction in interest rates, or when additional payments are made to reduce debt for any reason. Factors affecting prepayments include general economic activity, seasonal factors, and recent mortgage rate trends. For example, if mortgage rates are declining, prepayments will be lower if they are dropping to the lowest rate in the past 3 years versus the past 10 years. The most common benchmark for estimating prepayment was prepared by the Public Securities Association (PSA). Various multiples of it are used.

Collateralized mortgage obligations (CMOs) are fixed income securities backed by whole loan mortgages or mortgage pass through securities. In a mortgage pass-through, the interest and principal are allocated on a pro rata basis to each investor. In a CMO, however, the income from the mortgages is sliced into various layers called tranches ("tranche" is the

French word for slice). The first CMOs were sequential. That is, interest payments would go to each tranche, but all of the principal would go towards the first tranche until it was paid off. After it was paid, all of the principal would go to the second tranche, etc. CMOs have evolved since the first one was issued in 1983. Now there are floating rate (FRCMO), very accurate defined maturity (VADM) and planned amortization class (PAC) CMOs.

PAC bonds are very common. They get priority over the cash flow. As a result, they must have companion or support tranches to absorb any changes in cash flow due to uncertainty of prepayments, defaults, etc. Due to the predictable cash flow of PACs, their yield is lower than for support bonds.

They also have Z accrual, interest only and principal only CMOs. Under a Z accrual bond, the interest is paid in the form of additional bonds. This permits the other bonds to be paid off quicker and gives the Z accrual bond a much longer average life. The interest only and principal only CMOs are difficult to price. For example, if interest rates were to decline and prepayments increased, the prepayments would eliminate any future interest payment and would also eliminate the discount period for the payment of principal, increasing the value of the principal only CMO.

Another comparatively recent innovation is **asset backed securities** (ABS). The majority of these are backed by car loans or credit card receivables. These securities usually have high quality and favorable yields. Compared to CMOs, their prepayments are unaffected by changing interest rates.

Convertible bonds are bonds that, at the option of the holder, may be converted into a fixed number of shares of common stock.

Investment in **non US bonds** adds diversification. Very few countries outside of the US have a large corporate bond market. This is attributable to policies that favor bank financing or issuance of additional stock. There are a lot of government bonds available. A major source of return and risk is currency exposure. The majority of currency exposure can be eliminated by hedging with forward contracts. Foreign exchange rates will adjust to ensure identical return from investing in risk free instruments of any country, assuming that proceeds from investment will be repatriated into the home currency by forward currency contracts entered into at the beginning of the holding period. This is known as the “interest rate parity theorem” and is similar to the “no arbitrage principle” discussed below. The currency risk can usually be actively managed. The best results are obtained from portfolios where only part of the currency is hedged away.

A “Eurobond” is a bond denominated in a currency that is not native to the country where it was issued. For example, a Eurodollar bond would be denominated in dollars issued outside the US. There are also Euroyen bonds denominated in yen issued outside Japan, and Eurosterling bonds denominated in sterling issued outside Great Britain.

Risks associated with bonds include interest risk, reinvestment risk, liquidity risk, and default risk. Interest risk is that if interest rates rise, the value of the bonds will fall. Reinvestment risk is that if interest rates fall, then coupons and maturity payments will have to be reinvested

at a lower rate. Liquidity risk is the inability to sell a bond at a specific point in time due to lack of trading in that bond or high bid ask spreads. Default risk is the possibility that the bond issuer will go bankrupt and be unable to redeem the bonds when due.

Duration is a measure of interest or price sensitivity for a bond. It can be defined as the weighted average time to receive the value of the interest and principal payments. It is equal to the sum of the time to receipt multiplied by the present value of each item of cash flow, divided by the total present value, or $\sum n PV CF / \text{total PV}$. This is the definition of “Macaulay duration”. “Modified duration” is equal to Macaulay duration divided by $(1 + i)$, where i is the interest rate divided by the number of payments in a year. This is also equal to the first derivative of the price of a bond with respect to the interest rate.

The change in price due to a small shift in the interest rate is approximately equal to minus the modified duration, times the change in interest rate, times the price. For example, a 10 year bond with a 6% coupon rate payable semiannually with a 7% bond equivalent yield (3.5% yield for 6 months) would have a modified duration of 7.30372 and a value of \$92.89. If the bond equivalent yield increased to 7.10%, then the price should decrease by \$92.89 (price) multiplied by .10% (the increase in interest rate) multiplied by 7.30372, or \$0.68. This is very close to the actual change in value. This concept does, however, assume a parallel shift in the yield curve.

For asset liability matching, it is common to take the duration of liabilities into consideration when constructing a bond portfolio.

When the value of a bond is graphed with respect to interest rates, the curve is convex. Duration as the first derivative measures the slope of the value of the bond at the specified interest rate. The further out from the intercept of the slope and the value of the bond, the larger the discrepancy between the value of the bond at the other interest rate and the slope at the initial interest rate. **Convexity** is used to measure the rate of change of duration. It is the second derivative of the price of a bond with respect to the interest rate. For t periods,

$$\text{convexity is equal to } (\sum t * (t + 1) * CF / (1 + i)^{t+2}).$$

The change in price due to convexity is $\frac{1}{2} * \text{convexity} * (di)^2 * \text{initial price}$. For a given yield and maturity, the lower the coupon rate and the greater the convexity. For a given yield and modified duration, the lower the coupon rate the smaller the convexity. Why? The exponents in the bond pricing equation cause convexity. The more money exposed to the bigger exponents, the greater the convexity.

Equity Investments

Stocks are unsecured assets that indicate ownership in a corporation. The classes of stock include preferred stock and common stock. Preferred stock pays either a fixed rate or variable rate dividend that must be paid before the owners of common stock get a dividend. Fixed rate dividends are expressed as a specified percentage of par value or \$x per share. Variable dividends are paid from adjustable-rate preferred stocks (ARPS). The rate will be a fixed spread above or below the Treasury yield curve. If a dividend is missed but accrues until it is

fully paid, then it is cumulative preferred stock. The alternative is noncumulative preferred stock, which is pretty rare. If a dividend is not paid, there may be restrictions imposed on management.

Dividends on preferred stock are treated similarly to common stock dividends for tax purposes. That is, the dividends are not tax deductible, but 70% of the dividends received by a corporation are exempt from tax.

Common stock can be classified as growth stock or value stock, large cap, small cap or micro cap, or income stock. Growth stocks are stocks for companies with earnings that are expected to grow faster than average. This expectation is reflected by higher price to earnings per share (P/E) ratios. "Large cap" refers to large capitalization, or market value. This is measured by the market price per share multiplied by total shares. Stock for companies in the Standard and Poor's 500 are considered to be large cap stocks. "Income stocks" are denoted by high dividends. They usually occur in mature industries.

Investing in non-US stocks will diversify the portfolio. One difficulty in investing in non-US companies is the difference in accounting disclosure requirements. The definitions underlying financial ratios may not be consistent everywhere. There is also currency exposure to consider.

Another area to consider is **emerging markets**. The return for these markets can be pretty high, but is commensurate with the risk. Considerations with respect to these investments include lack of reliable information, currency risk, a poor legal infrastructure that may permit insider trading, potential impact of political instability, different accounting systems, transaction costs, shareholder rights, and ability to recover your investment. Also of considerable importance is whether or not the country is working to improve its infrastructure for attracting foreign capital. This includes the role of nonbank financial intermediaries.

Private equity is money invested in companies that are not traded in the stock market. One example of this is venture capital which provides financing for start-up companies. It can also be used to purchase publicly traded companies and convert them into private companies.

Hedge funds can encompass a wide variety of investments. They can include long and short positions in equities and other liquid asset classes. A long position is owning the asset and a short position is owing the asset, so for example, the fund could own stocks expected to outperform the market and owe stocks to a broker that are expected to underperform the market. Hedge funds can be market neutral, discussed further below; designed to take advantage of arbitrage opportunities or pricing inefficiencies due to anticipated corporate events such as mergers, credit reclassification or potential bankruptcy.

Commodities include oil, gas, metals, grains, food/fiber, and livestock.. Commodities are typically bought and sold in future contracts, which specify the number of commodity contracts, the commodity, the delivery date and location and payment terms. A contract for grain is 5,000 bushels, for crude oil: 1,000 barrels, for copper: 25,000 pounds. If they are

bought on margin, there is daily settling up of any price changes. Most contracts are negated prior to the delivery date

Contracts may be entered into to fix a price well in advance. For example, a farmer and bread maker may enter into a contract in the spring that will fix the price of wheat in the fall. Supply and demand will dictate the price. Clearly, the actual price will change if there is a drought or an abundant harvest. A Commodity Exchange will connect the parties.

When the price of a commodity goes up, the profitability of the companies using that commodity tends to decline, and vice versa. As a result, commodities tend to have a negative correlation with the stock market.

Similar to stocks, commodity futures contracts are very liquid and can be bought and sold at any time. Unlike stocks, the price of commodities will not decline to zero. Also similar to stocks, you can trade call and put options on commodity futures contracts. They also have investable index funds.

Infrastructure includes transportation and utilities. A developing country will need transportation such as roads, rail, air, and possibly a good developed harbor, to get goods to market. The demand for reliable power to produce goods is enormous. It will enable factories to run around the clock. There is also a large need for communication and internet access.

Warrants are issued by a company and are analogous to a long term option to buy a specified amount of shares of stock at a specified price. The term is usually at least 2 years and they are usually issued in conjunction with a bond sale. The exercise price may rise over time as specified in the bond's indenture.

Derivatives "derive" their value from another asset. Derivatives include call and put options, futures, convertible bonds, convertible preferred stock, swaps and forwards. A "call" is an option to buy an asset at a specified exercise or strike price until a specified date, and a "put" is an option to sell an asset at a specified exercise price until a specified date. An American option can be exercised at any time before or on the expiration date but a European option can only be exercised on the expiration date.

A forward contract is a contract between two parties with respect to the purchase and sale of a commodity at a future date. These contracts are private agreements.

Drawbacks to forward contracts include lack of liquidity and the possibility of the party on the short end failing to fulfill the deal. These drawbacks are overcome by futures contracts, which are traded on an exchange, such as the Chicago Board of Trade, and regulated. When a futures contract is initiated, each party will post an initial margin with a clearinghouse, which guarantees performance. Each day, traders are required to post any losses that they incurred. This is referred to as marking to market. If the initial margin falls below a maintenance margin, then the trader is required to deposit enough to bring it back to the initial level. To achieve liquidity, futures contracts precisely specify the product, delivery date, minimum

price fluctuation or tick size, and method of closing the contract. The vast majority of contracts are settled by an offsetting trade.

A futures contract can be for a commodity, an interest earning asset, foreign currency, or an index, such as the S & P 500 index. Futures contracts meet the needs of 3 groups: those who wish to discover information, those who wish to speculate, and those who wish to hedge.

Arbitrage is the simultaneous purchase and sale of equivalent assets to make a profit with virtually no risk of loss. In an efficient market, there should be no arbitrage opportunities. The **no arbitrage principle** states that any rational price for a financial instrument must exclude arbitrage opportunities. The possibility of arbitrage does, however, practically dictate the price of futures. The futures price must equal the spot price plus the cost of carry to the delivery date, plus or minus transaction costs and storage costs.

One way to see if an arbitrage opportunity is available is to compare the financing cost to the “implied repo rate”. The implied repo rate is equal to the futures price divided by the spot price, minus 1, or $F_{0,t} / S_0 - 1 = C$, the cost of carry or implied repo rate. If the repo rate is larger than the financing rate, then the investor should buy the bond, sell the futures, and hold the bond for delivery against the futures. This is known as cash and carry arbitrage. If the implied repo rate is less than financing cost, then the investor should exploit reverse cash and carry arbitrage; i.e., buy futures, sell the bond short, invest proceeds until futures expire, take delivery on futures, then repay the short sale obligation. This can be illustrated by looking at a T-bill futures contract with a face value of \$1,000,000, for example.

If the contract called for delivery of a T-bill with 90 days to maturity at expiration, and the future was for delivery in 120 days, the steps would be as follows:

1. Using an expected yield of 10%, this T-bill would be expected to have a value of \$976,454 at delivery ($\$1,000,000 / 1.10^{90/360}$). T-bill yields are quoted in terms of 360 days.
2. The yield on a 120 day T-bill is 4.0%. This would have a value of \$987,012 ($\$1,000,000 / 1.04^{120/360}$).
3. There is a 210 day T-bill with a yield of 7.0%. This would have a value of \$961,301 ($\$1,000,000 / 1.07^{210/360}$).
4. The implied repo rate is 4.8038%, or the value in item 1 divided by the value in item 3, raised to the 360/120 or annualized. This rate is higher than the 4% finance rate in item 2.

So the investor would proceed to implement a cash and carry arbitrage as follows:

1. Borrow \$961,301 at 4.0% interest for 120 days and buy a T-bill that would mature in 210 days. This is equal to the amount in item 3, above.
2. Buy the 210 day T-bill with borrowed funds and hold it.
3. Sell the future for \$976,454, which is the value in item 1 above.
4. Hold the T-bill for 120 days and deliver against the future for \$976,454.
5. Repay the loan which would equal \$973,951 ($\$961,301 * 1.04^{120/360}$).
6. The risk free profit would be \$2,503.

The no arbitrage principal says that the above should not happen. This would have been prevented if future return was equal to 11.135%.

The example above assumed that the conditions of the capital asset pricing model were true, that investors could borrow or lend any amount of money at a risk free rate. In the real world, it is difficult to borrow at the risk free rate. Instead, a financing rate would be charged

The **put-call parity relationship** is another example of the no arbitrage principle. This relationship says that a put is equal to a call minus the stock price plus an investment in a risk free bond. Mathematically, $p_t = c_t - S_t + Xe^{-r(T-t)}$, which shows how to synthesize a put. Extending the logic, any of the above can be synthesized given the other three.

This note would be remiss if it did not mention the “Black-Scholes option pricing model”. It is a mathematical model to determine the price of a call option. The input items are the current stock price, the strike price, time until expiration, risk free interest rate, and the expected standard deviation of the stock. The initial model was designed for European call options for stocks that do not pay dividends. Merton extended it to include dividends.

Interest rate futures can be used to hedge. For example, if a pension trustee were going to receive a \$5 million contribution in 4 months and wanted to lock in current rates, he could buy 5 future contracts today that would be payable in 4 months. Futures can also be used to change the duration of a portfolio. At the time of purchase, the value of a Treasury bond future is close to zero. There will be a considerable change in value, however, if there are changes in interest rates. So buying a Treasury bond future will increase the duration of a portfolio. Alternatively, if a Treasury bond future is sold, the value will move in the same direction as the interest rates, which will shorten the duration. The only interest rate futures that can be hedged are treasuries with 2, 5, 10 and 30 years to maturity.

Index futures are also useful. S & P 500 index futures, for example, trade on the March, June, September, December cycle. Index arbitrage will force the cost of the future to be the financing cost offset by the expected value of dividends. A single contract for the S & P 500 future is equal to 250 times the index amount. If a plan sponsor wished to lock in the current value of equities, due to fears of a bear market or a potential plan termination in 6 months, he could sell index futures. The portfolio would be hedged if the number of contracts to be sold was equal to the value of equities divided by (250 * the S & P index future amount). To compensate for differences in volatility, the resultant amount should be multiplied by the beta of the portfolio in relation to the S & P 500. Under these circumstances, the equity portion of

the portfolio would grow at the financing rate. Various other indices are also covered in the futures market.

A **swap** is an unregulated agreement between two or more counterparties to exchange cash flows over a period of time. The agent who brings the counterparties together is called a swap facilitator. The lack of regulation enables the counterparties to have very flexible customized contracts. The creditworthiness of the counterparties is very important. There are interest rate swaps and currency swaps.

An interest rate swap entails one party paying fixed interest and the other party paying a floating rate of interest. Typically, only the difference in cash flow is exchanged. For most swaps in the US, the floating rate is equal to either the three or six month London interbank offered rate (LIBOR) plus X%, determined at the beginning of each period. The floating rate may have a cap or a floor. The payment conventions may differ. The fixed rate is usually either actual number of days divided by 365, or the “30/360” rule, multiplied by the fixed rate. The floating LIBOR is usually the actual number of days divided by 360, multiplied by the fixed rate.

For an example based on need, a bank that receives mortgage interest at a fixed rate and pays variable interest in the form of CDs would have an asset liability mismatch. The mismatch would be partially eliminated if they could exchange their fixed interest receipts with a counterparty’s floating interest receipts.

Currency swaps are a bit more complicated for three reasons. First, the principal amount is exchanged at the initiation and maturity of the contract. The actual amount at each time is based on the exchange rate in effect at the initiation point. Second, the total amount, not the net cash flow, exchanges hands each time. Third, because of the different currencies, the interest rates can be both fixed, both floating, or one of each. The most common way is for a fixed rate in foreign currency and a floating rate in US dollars.

Investments in **real estate** can increase diversification. This may increase return as well as reducing overall portfolio risk. Investment in real estate calls for skill in management and knowing the local areas extremely well. It is also much more difficult to obtain good, reliable data for real estate than stocks or bonds. This includes difficulties in quantifying risk. There are some similarities between valuing real estate and valuing fixed income securities and stocks. The valuation of lease payments is comparable to valuing bonds, but the value at the end of the lease is dependent on local supply and demand. Property types include office space, retail, industrial, apartment, and raw land. Other market segments include geographic location, population growth and density, property life cycle, tenancy type, and lease periods.

Real estate also presents liquidity problems. This led to the creation of real estate investment trusts (REITs). These are companies that manage real estate. Shares in REITs trade over the stock exchange.

A **market neutral fund** is an equity fund that is half long and half short. The owner has a long position. In contrast, if a pension trustee borrowed some shares from a broker and sold

them, the pension fund would have a short position until the shares in that company were repurchased and repaid. An actively managed equity fund has stocks that are expected to increase. A market neutral fund would own some stocks expected to increase and have sold some borrowed stocks expected to decline in value. For example, if a pension trustee borrowed and sold 1,000 shares of XYZ Company at \$40 per share and then the price declined to \$25, the trustee could repurchase and repay the 1,000 shares for \$25,000. The profit would be \$15,000, offset by transaction costs and the cost of leaving collateral with the broker for borrowing the stock. The trustee would also have to pay any dividends received to the broker.

There are definitely risks involved for a short sale. The potential loss is comparable to selling an uncovered call and the gain is comparable to buying a put. There does appear to be increasing interest in including short sales in actively managed portfolios. A short fund will have negative correlation with an equity fund, which can enhance the efficient frontier.

Footnotes

1. ERISA 404(a)(1)(A)
2. ERISA 404(a)(1) (b) and (C)

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