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The ~~Three~~, ~~Four~~, ~~Five~~ … P's of Pricing and Risk Management Revisited

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Traditional pricing and risk management principles have to be reconsidered in the light of the involvement of large public and private participants in the market for securities. This article explores the impact of the actions of participants on the building blocks of asset pricing models, and their impact on asset pricing and risk measurement. This discussion re-emphasizes the need for simple principles for asset selection and portfolio construction.

A financial engineer will tell you that he or she can price any asset if given the basic trio of P's: Payoff, Probability and PV (Present Value). A relative value trader will add to this list the prevailing price of related securities. Using the pricing of closely related securities, the relative value trader or arbitrageur first calibrates a risk-neutral model, and then uses it to price the security at hand. On the other hand, a long-term investor interested in the absolute value of securities will add to this list of P's his preferences via a utility function. How much the performance of the security adds to the utility of the investor's portfolio determines the price the investor is willing to pay.

Events of last year have forced us to add to this plethora of P's another one that modelers have largely ignored but cannot any longer: participants, both "Public" (the government) and Private. The purpose of this note is to explore pricing and risk management of portfolios in an environment where public participants are having an increasingly potent impact on valuations and market functioning. The string of recent announcements of various public sector initiatives renders this exercise far from simply academic.

Asset Pricing Revisited

Let us review how pricing works with the three basic P's. Let's take the example of a simple corporate bond that pays off par if there is no default, and zero if there is a default (i.e., no recovery value). In this example we have only one probability: the probability of default. The probability of no-default is just one minus the probability of default. To obtain the current fair price, we discount the probability-weighted future random price. In other words, the price is simply obtained by averaging all random outcomes by taking the "expectation" of PV × Probability × Payoff. To summarize, for the defaultable bond:

Current Price = PV × Probability of Not Defaulting × Par

Now let's explore how participants can impact the right hand side of this equation; first, they can guarantee "no default." Second, they can tilt odds so that there is less symmetry in the outcomes, i.e. by making the probability of not defaulting higher. Finally, they can attempt to change the discount factor. The net effect is that a public participant with an infinite amount of capital can theoretically make prices of securities whatever it wants them to be.

It is hard, if not impossible, to argue with any degree of conviction whether participant actions of the magnitude we have seen so far are good or bad in the long run. However, we can still look back at recent events and enhance our pricing framework.

To put the discussion in the context of what we have recently observed, we first note that the government's guarantee of loans from banks (e.g., through FDIC guarantee) can be construed to be an attempt to alter payoffs, since it substantially reduces the likelihood that the lender would get anything less than the par amount. Opening up credit lines and accepting collateral in exchange for Fed loans presumably reduces the probability of liquidity-driven default risk (e.g. under the new term repo facilities). Outright purchases of Treasuries, especially in the long end, as well as purchases of Agency mortgages may be translated as an effort to raise asset prices by reducing the discount factor. A stunning example of the impact of such actions on pricing of risk premium is shown in Chart 1. The Fed announced on March 18, 2009, that it would purchase up to $300 billion of long Treasuries, which resulted in an intraday jump in the long bond futures contract of 4.82% on the news. From a risk management perspective, this is massive, since the annualized volatility of the bond futures contract in the options market is currently "only" 25%, which is extremely high by historical standards. Under the assumption of a lognormal price distribution, this annual implied volatility translates to only 1.5% daily volatility, i.e. the best estimates of market participants were only a third of what was delivered on that day. This suggests that market pricing going forward should pay more heed to fatter-tailed events.

Intraday U.S. Bond Futures Price Performance March 17–19, 2009

Source: Bloomberg

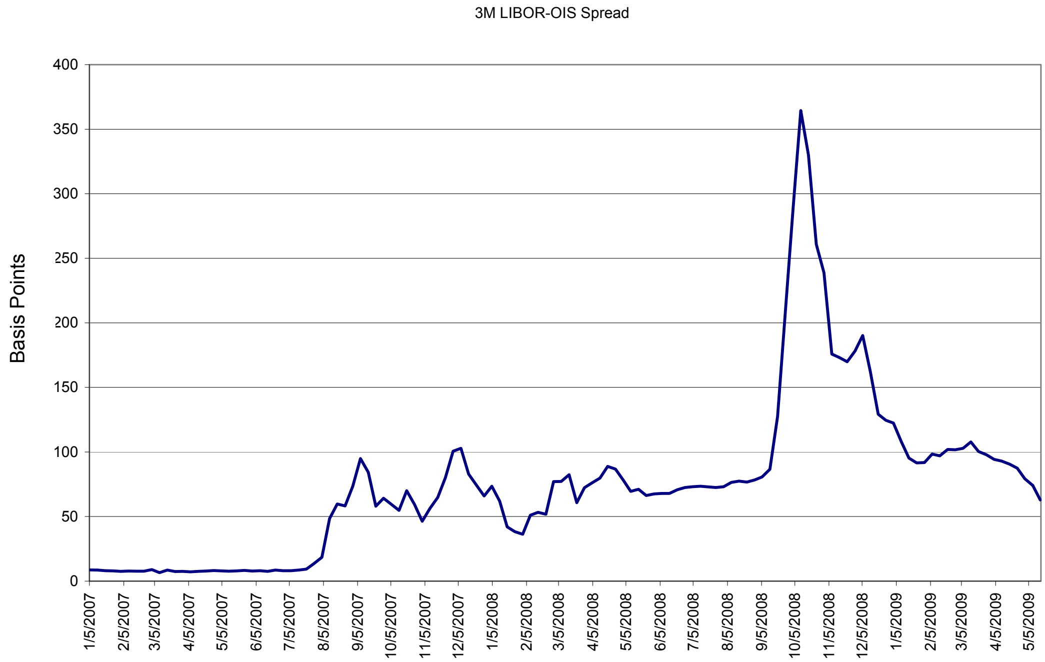
Chart 1

The government has also stepped in to provide leverage to investors via non-recourse loans against consumer asset-backed securities (ABS) (via the Term ABS Loan Facility (TALF)). A hypothetical example might make the impact on pricing clearer. Under the TALF program, each type of underlying collateral will have a Fed-designated haircut, i.e. the amount of money that the investor has to put up. Assuming the haircut is 7%, an investor can obtain 93% of non-recourse funding from the Fed, i.e. a loan which is secured by and the lender's recovery is limited to the underlying pledged collateral. So that means if an investor has $7 they can borrow $93 and the total buying power is now $100. Assume further that the rate on the loan is LIBOR +100. Then the borrowing cost per $100 invested is $93×(L+100). Suppose the asset returns L+200; then the gross return to the portfolio is $100×(L+200). The return on equity to a levered TALF investment equals the net portfolio return (i.e. gross return − borrowing cost), divided by the investor equity; i.e. ($100×(L+200)) − ($93×(L+100)) / $7 = L+1529.

This asymmetric payoff has resulted in many recently issued TALF-eligible securities outperforming their non-TALF-eligible counterparts by a huge margin. Since the loan for each security is separate from the loans and asset values of all other securities, a portfolio of levered TALF holdings is a portfolio of puts (see the Master Loan and Security Agreement: http://www.newyorkfed.org/markets/TALF_MLSA.pdf). It is easy to understand the asymmetric impact of this on security prices, since a portfolio of put options is much more valuable than a put on the portfolio. In a similar vein to our bond futures example, note that with the announcement on May 20 that commercial mortgage-backed securities (CMBS) would become eligible for TALF, the prices of these securities immediately jumped up. CMBX AAA indices (which comprise TALF-eligible bonds), jumped up by 5.9% between May 19 and May 20, 2009. Initially other CMBS securities also showed similar price gains, but those that were not eligible for public funding immediately started to lose their gains.

There is further evidence that targeted liquidity provision is leading to disperse outcomes. As Chart 2 below shows, the impact of the massive amount of liquidity injected by the Central Bank has resulted in the compression of the LIBOR-OIS (overnight indexed swap rate) spread. This spread is a good measure of the short-term default risk in the banking sector. Since LIBOR is also used as a reference for the quotation of risky product spreads, making this spread narrow is tantamount to guaranteeing a lower risk premium for risky products that are indexed off this rate.

3-Month LIBOR-OIS Spread



Source: Bloomberg

Chart 2

At this stage of the discussion, private participants and their preferences have to be considered. Private participants prefer more profits to less, and all else being equal, they prefer profits that come sooner to profits that come later. Public participants may well have a different objective function, e.g. they may prefer longer-term prosperity over shorter-term profits. For instance, they might want to stabilize housing markets at any cost since this stabilizes so many other economically important variables. This creates a delicate equilibrium in which security prices are the result of a balancing act between the two different sets of preferences.

There is another subtle aspect of this pricing calculus that so far we have ignored. We assumed that the averaging over scenarios (or the calculation of "expectation") remains unchanged. But this assumption also needs to be challenged. If the distribution of security returns can be modified willy-nilly or is unknown, then the expectation cannot be reliably computed; in this case the price cannot be determined with any degree of accuracy regardless of complete knowledge of the discount factor and the payoff. This type of uncertainty is the most perverse, and all else being equal, tends to depress prices toward lower values. This lower bound of security prices is then the most pessimistic outcome under any distribution. The fatter the tail of the distribution, the more likely the possibility that the market discounts the price to be closer to the tail. Without public participants, securities would naturally fall toward this lower bound. The only possible cure is for the public participant to select certain asset classes and securities that have a substantial possibility of adversely impacting the social good, and bid up their prices. In doing so, they short-circuit the basic pricing calculus and change the arithmetic from one based on probability to one based on their selection criteria.

Finally, we know that prices of securities have multiple purposes: One of the primary purposes is the information content of the price. As a matter of fact, our financial engineer can extract the information content embedded in the price by the process of calibration of the prices to the basic trio of P's we mentioned at the start of this article. Once the price becomes subject to the impact of a participant, the calibration process fails. Since calibration of future price evolution is based on the availability of reliable (and – under risk-neutral pricing – tradable) information on prices of all maturities, this failure to calibrate introduces a path-dependence on valuation even for assets that are basically path-independent under the classic 3 P pricing framework.

Risk Measurement in the New World

What about risk management of portfolios in such an environment? The market risk to a security is the sensitivity to shocks to the trio of P's above. For many complex securities, the payoff depends on the path (another P) taken by the security. For instance, for mortgage-backed securities the balance in a mortgage depends on the path of prior prepayments and defaults; shocking the parameters that define the probability distribution of prepayments and defaults changes the price of the mortgage security. Now include into the risk model the participant who can change any of the basic trio of P's and we have a new risk factor, i.e. the magnitude and frequency of its actions. Unfortunately this risk factor lies beyond the reach of traditional risk management models.

The existence of a wide variety of traded instruments in the market has helped facilitate the ability of participants to transfer risk among each other and to "hedge" out the unwanted risks. To hedge against the risk resulting from the actions of a public participant, we would either need securities that adjust immediately to their actions, or a blanket guarantee that the public participant would mitigate any risk arising from its own actions. To our minds, such securities (with perhaps the exception of sovereign bonds) are not easily available. The impactful actions of participants can thus make formerly complete markets into incomplete markets. I am sure the investment community will rush in to fill this gap as derivatives markets recover.

An interesting example for risk measurement is found when computing interest rate durations of floaters. Floaters are simply fixed income instruments that pay some contractual spread (known as discount margin) above a floating rate index such as 3-month LIBOR. As long as the bond is trading close to par, we know that the interest rate duration on this floater is close to the reset period. Now if the issuing corporation suffers a decline in its credit quality, the contractual margin will not be sufficient to compensate investors for increased default risk. This translates into a lower price for the floater, or stated another way, a market spread that is much larger than the discount margin. One can think of the discounted floater as a long position in a par floater and a short position in an annuity that pays the difference between the margin and the market spread. As the market spread becomes much larger than the margin, its impact on the risks of the floater grow. The outcome is that a long-term, discount floater can have a large negative interest rate duration, i.e. as LIBOR rates rise, the price of the floater rises rather than falling. Another way to see this result is that as the credit deteriorates, the front-end cash flows are more likely to be received, whereas the bond principal might not be received due to defaults. So as LIBOR rises, the front end coupons increase in value.

But putting the government in the mix can easily change this most fundamental of risks. First, with an infinite amount of capital, the spreads can be driven down to make the bond trade like a par bond, trivially making interest rate duration positive. Second, the government can make an implicit change to the payoff on the bond by a reduction of the face value of the bond (e.g. under "burden sharing"), and a guarantee of no further defaults. This bond again has negligible non-negative interest rate duration.

Our example shows that when participants are able to have such substantial impact on capital markets, not only do prices become hard to assess, but risk measurement can become a very difficult task. The quantitative metrics we have relied on to make investment decisions become very blunt tools and can give widely conflicting results.

Conclusions

What can one do to manage the valuation and risks of portfolios in this environment of greater public sector involvement in a range of markets? First and foremost, absolute valuation of securities should take precedence over relative valuation, because there is considerable uncertainty as to which security can be targeted for a new paradigm price. Second, security prices are likely to reflect, even more than they have before today, the macroeconomic conditions that are likely to prevail. The relevance of economic intuition in pricing models becomes even more important.[1] Third, diversification based on traditional measures of risk and return and co-movement relationships can break down as a new common factor becomes critical in determining outcomes. Much of this has already been documented even prior to the height of the current crisis.[2] Identifying the key factors that will be relevant for risk management should take precedence over forecasting returns, volatilities and correlations. Finally, in a world where public and private preferences, which have different horizons of measurement, come into conflict, markets should be expected to be more turbulent, and the concept of in-built "tail risk" hedges is critical, since we should expect to see more frequent "jumps" as illustrated in Chart 1.[3]

Of course this story will evolve over the next few years. I hope to have convinced the reader that the phenomenon of increasing influence from potent participants requires an approach where portfolios are constructed from first principles, and ranked according to their robustness to players' actions. In a world where historical normal period experience, even with decades of data, has little relevance to valuation, it should be no surprise to risk managers that risk management statistics and concepts are also candidates for challenge. While there is no one cure-all, fortunately the push toward simplicity in investment portfolios that the new environment requires should be a welcome development.

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Vineer Bhansali, Ph.D., is a managing director and head of analytics for portfolio management in the Newport Beach office. Prior to joining PIMCO in 2000, he was a vice president in proprietary fixed income trading at Credit Suisse First Boston. He is the author of numerous scientific and financial papers and of the book Pricing and Managing Exotic and Hybrid Options. He currently serves as an associate editor for the International Journal of Theoretical and Applied Finance. He has 19 years of investment experience and holds a Ph.D. in theoretical particle physics from Harvard University. He has a master's degree in physics and an undergraduate degree from the California Institute of Technology.

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Endnote:
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The hypothetical example contained herein is provided for illustrative purposes only and is intended to illustrate how the TALF program works. The example provided is hypothetical and is not based on actual results. No guarantee is being made that the stated results could be achieved.

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The LIBOR/OIS (Overnight Index Swaps) spread measures the amount of cash available for interbank lending and is used by banks to determine interest rates. LIBOR (London Interbank Offered Rate) is the rate banks charge each other for short-term Eurodollar loans. Swaps are a type of privately negotiated derivative; there is no central exchange or market for swap transactions and therefore they are less liquid than exchange-traded instruments.

The CMBX index is a basket of five components referencing 25 CMBS reference obligations that are tranches of commercial mortgage-related securities. The index is rated in each of the top five rating categories (AAA through BBB-). It is not possible to invest directly in an unmanaged index.