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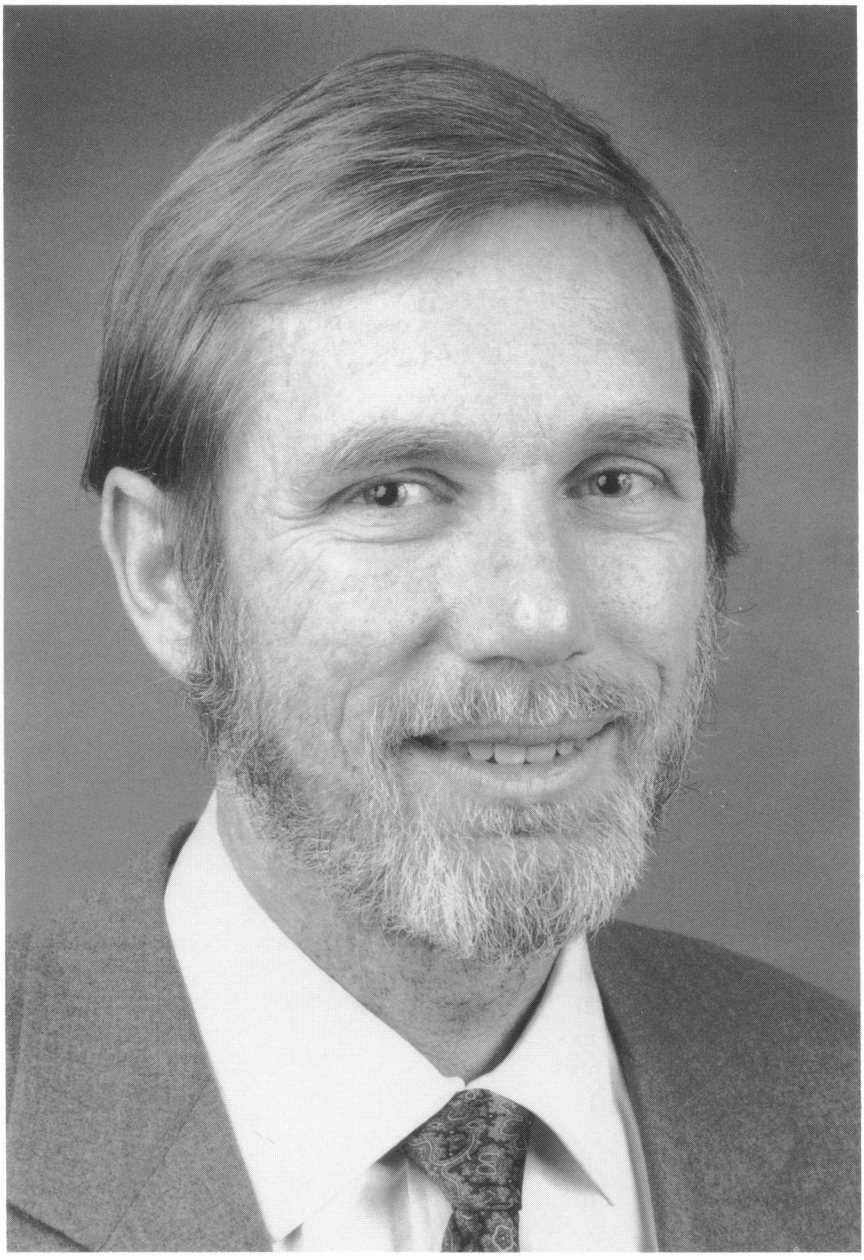

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Swaps: Plain and Fanciful

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ABSTRACT

The outstanding face amount of plain vanilla interest rate swaps exceeds two trillion dollars. While pricing and hedging of such swaps appear to be quite simple, many existing theories are based on the incorrect characterization of a swap as a simple exchange of a fixed for a floating rate note. This characterization is not consistent with standarized swap contracts and the treatment of swaps in bankruptcy. This paper provides an alternative perspective on swaps.

THE FIRST MAJOR SWAP occurred a little more than a decade ago. In August 1981 the World Bank issued $290 million in eurobonds and swapped the interest and principal on these bonds with IBM for Swiss francs and German marks. The rapid growth in the use of interest rate swaps, currency swaps, and swaptions (options on swaps) during the last decade has been phenomenal. Currently, the amount of outstanding interest rate and currency swaps is almost $3 trillion. More than two-thirds of these swaps are relatively plain vanilla fixed/floating interest rate swaps denominated in a single currency.

The first part of my talk focuses on fixed/floating interest rate swaps. While the hedging and valuation of fixed/floating swaps appears to be straight forward, there is more to these plain vanilla swaps than first meets the eye. Many existing theories value such swaps as exchanges of fixed and floating rate notes issued by the swap counterparties. However, the fixed rates quoted in the swap market do not reflect differences in borrowing costs between counterparties. Thus, these theories imply that swaps are mispriced and that two rational counterparties will not undertake a swap. The treatment of a fixed/floating interest rate swap in the event of a default is quite different from an initial exchange of fixed and floating rate notes. This difference is critical to understanding both the observed pricing of these swaps and the motivation for rational counterparties to enter into such transactions.

The second part of my talk considers some widely used interest rate swaps that are less well known among academics. While most financial economists are aware of relatively common swaps such as fixed/floating interest rate swaps, few are aware of more esoteric features such as U.S. dollar LIBOR paid in Japanese yen (i.e., no currency conversion). The relative lack of academic research on these more complex transactions is partially at-

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tributable to lack of publicity given to transactions that do not involve the issuance of registered securities. This part of my talk should be viewed as a sampler meant to whet the appetite of academic researchers. I will attempt to describe some representative interest rate swaps and then discuss the economic motivation for entering into such transactions. The gaps in my understanding should highlight the need for further research.

I. Interest Rate Swaps: Plain

The most widely used swap is a fixed/floating interest rate swap. The market for U.S. dollar interest rate swaps under 10 years is highly competitive. There are a large number of dealers offering these swaps, real time information on market swap rates is readily available to all market participants from services such as Telerate and Reuters, and the bid/ask spreads are less than 5 basis points (bp).

Superficially, the pricing and hedging of such a swap appears to be quite simple. While existing theories do provide useful insights into the pricing and hedging of fixed/floating interest rate swaps, they also make some incorrect predictions. Consider the following stylized facts based on casual empiricism over my sojourn as the Director of Research at a well known derivative products firm:

1. Because the aggregate notional amount of fixed/floating swaps outstanding is more than $2 trillion and most swap participants are rational, these swaps are not redundant financial products.
2. Swap spreads, the difference between term swap rates (the fixed rate on a term swap against a floating rate of LIBOR flat) and on-the-run government yields, do not display the volatile cyclical behavior evidenced by corporate bond spreads.
3. Quoted swap rates do not reflect credit rating differences between the counterparties; i.e., firms do not pay-up to do swaps with highly rated counterparties.

No existing theory or combination of theories explains all three of these observations.

A theory of interest rate swaps should provide economic motivations for rational fixed rate payers and rational floating rate payers entering into swaps, provide an explanation for the lack of cyclical variability of swap spreads (differences between swap rates and yields of on-the-run government securities), and explain why swap rates do not depend upon the credit ratings of the counterparties. While this paper does not purport to rigorously develop a theory of swaps, it attempts to provide the principal elements for such a theory.

Existing theories will be illustrated in the context of a 10 year U.S. dollar interest rate swap in which one party pays a fixed interest rate and its counterparty pays a floating interest rate, six-month LIBOR, on a prespeci-

fied notional amount of $100 million. This seemingly simple swap will be viewed at increasing levels of complexity.

A. Valuation of Swap as an Exchange of Fixed and Floating Rate Notes: Model A and Model T

The initial analysis, referred to as Model A, abstracts from both differences in credit ratings between swap counterparties and the possibility of credit rating downgrades. Both counterparties are assumed to be A-rated and have identical borrowing costs for the duration of the swap. It is tempting to dismiss this model as a strawman. However, the insights gained from this model are useful for understanding the valuation and hedging of swaps based on observed swap spreads for active swap maturities, eurodollar futures, and on-the-run government securities. Indeed, the implications of Model A are quite similar to the common industry approach to valuing and hedging swaps.

Assume that both counterparties are able to issue ten-year noncallable fixed rate notes at 125 bp above the ten-year Treasury rate, and are able to borrow short-term at six-month LIBOR flat. Under the ten-year swap, Firm A1 pays the ten-year fixed swap rate and receives the six-month LIBOR rate semi-annually on a notional principal amount of $100 million. Inversely, Firm A2 pays the six-month LIBOR rate and receives the 10-year fixed rate semi-annually on a notional principal amount of $100 million.

Model A characterizes a fixed/floating interest rate swap as an exchange of two notes. Consider the exchange of a $100 million ten-year fixed rate (noncallable) note issued by Firm A1, the fixed rate payer, for a $100 million 10-year LIBOR floating rate note issued by Firm A2, the floating rate payer. Assume that the fixed coupon on the fixed rate note is equal to the ten-year swap rate and the variable rate on the floating rate note is LIBOR flat. Under this exchange the net interest payments, the difference between the fixed and floating note interest payments, and the net final principal payments, zero, are identical to the net swap payments.

Under Model A the hypothetical floating rate note with a variable coupon of LIBOR flat issued by Firm A2 is presumed to sell at par on its LIBOR reset dates. This premise is "proved" recursively for an issuer who is able to borrow short-term at LIBOR flat. In nine-and-a-half years the floating rate note would be identical to six month LIBOR paper and would sell at par. In nine years the interest payment in six months would be set at the then current LIBOR rate. An investor who held the floating rate note for six months would, therefore, receive the same interest as on six-month LIBOR paper and sell the floater for par. Thus, in nine years the floating rate note with a remaining maturity of one year would be a perfect substitute for six month LIBOR paper. This recursive "proof" may be used to show that for each reset date the floating rate note would sell at par. A hypothetical fixed rate note, issued by a LIBOR flat short-term borrower, with a coupon equal to the current ten-year swap rate is also presumed to sell at par. This approach

values a swap to the floating rate payer as the value of the hypothetical fixed rate note, based on a term structure of zero swap rates, less the value of the hypothetical floating rate note, which is assumed to be 100 on the reset dates.

A "fair" swap rate denotes the fixed rate that when swapped against LIBOR flat results in the swap having a zero market value. Under Model A, the above described swap would have a zero market value if and only if the market value of the hypothetical ten-year fixed rate note issued by Firm A1 equaled the market value of the hypothetical floating rate note issued by Firm A2. Competitive interactions would result in swaps having zero market values at the initiation date. Under Model A the fair swap rate in our example is equal to the ten-year Treasury rate plus a spread (the swap spread) of 125 bp.

Model A appears to be overly simplistic because it side-steps credit rating differences between the swap counterparties and does not take account of the impact of potential future downgradings of short-term borrowing costs. However, at a superficial level the valuation and hedging implications of Model A are consistent with industry practice. It is common industry practice to obtain a term structure of zero swap rates by interpolating from swap spreads for active maturities, eurodollar futures, and on-the-run government securities. The interpolated zero curve is used to value a hypothetical fixed rate note with a coupon equal to the contractual fixed swap rate. The hypothetical floating rate note is valued at par on reset dates, and the swap is valued as the difference between the estimated values of these two hypothetical notes. The common industry practice of valuing swaps does not consider differences in the credit ratings of investment grade counterparties. In spite of the similarities to model A, the common industry approach to valuation of swaps is less naive than it superficially appears. Indeed, I will subsequently argue that it is on firmer ground than approaches that take explicit cognizance of differences in the actual terms upon which swap counterparties can issue fixed and floating rate notes.

Model A side-stepped differences in credit ratings by focusing on two A-rated counterparties that have identical borrowing costs. It does not provide an economic rationale for the industry practice of quoting the same swap rates to counterparties with different credit ratings.

This model also implies that swap spreads should display a cyclical volatility that is similar to the cyclical volatility of A-rated corporate bond spreads. In contrast the common industry approach to valuing swaps directly observes swap spreads for active maturities and does not determine swap spreads based on corporate bond spreads of A-rated issuers. Thus, the common industry practice of valuing swaps has no implications concerning cyclical variations in swap rates. While swap spreads do vary over time, they do not display the extreme cyclical volatility that is evidenced by corporate bond spreads.

A possible explanation for the relative stability of swap spreads relates to the risk of credit downgrades and the resulting impact on the firm's short

term borrowing cost. Wall and Pringle (1987) note that combining LIBOR flat borrowing for the initial six months with semi-annual rollovers at uncertain spreads over LIBOR for the next decade is not a perfect substitute for a ten-year LIBOR floater. The recursive proof of the equivalence of a LIBOR floater and a series of short-term LIBOR loans is incorrect because it does not account for the possibility of future credit rating downgrades that could raise short-term borrowing costs above LIBOR. Firms with single A credit ratings who are able to borrow for six months at LIBOR flat are unable to issue ten-year floaters at LIBOR flat. While ten-year floaters are uncommon in the domestic U.S. dollar bond market, they are frequently issued by banks in the eurobond market. A premium of 50–100 bp over LIBOR for a ten-year A rated floating rate note is reasonable.

Under the common textbook characterization of a fixed/floating swap, referred to as Model T, the swap is also characterized as an exchange of the fixed rate payer's fixed rate note for the floating rate payer's floating rate note. However, a floater paying LIBOR flat is not presumed to sell at par on reset dates. The original exposition of this theory is contained in Turnbull (1987). Momentarily, assume that all swaps are between A-rated counterparties having identical borrowing costs. This suggests that the "fair" swap spread is the spread over Treasuries for A-rated bonds less the spread over LIBOR required for A-rated floaters to sell at par. Assume that firm A2 is able to issue a floater at LIBOR plus 75 bp, under these conditions, the "fair" ten-year swap spread is 50 bp.

This model predicts that swap spreads will not display the cyclical volatility evidenced by A-rated corporate bond spreads. If increases (decreases) in corporate bond spreads over Treasuries were associated with similar increases (decreases) in spreads over LIBOR on floating rate notes, there would be no effect on "fair" swap spreads.

Now consider a modification of the example to allow for differences in credit ratings. Assume that Firm A1, an A-rated firm, remains the fixed rate payer and that the swap spread is still 50 bp, but an AAA entity is now the floating rate payer. Assume that AAA-Agency is backed by the full faith and credit of the U.S. Treasury and is able to issue a ten-year floater at LIBOR minus 10 bp, six-month paper at LIBOR minus 20 bp, and a 10 year fixed rate bond at Treasuries plus 30 bp (ten-year swap rate minus 20 bp). Under model T, "fair swap rates" fully reflect the cost at which the fixed rate payer is able to issue a fixed rate note and the cost at which the floating rate payer is able to issue a floater. The "fair swap rate" in a swap in which firm A1 pays fixed and AAA Agency pays floating is 135 bp. The "fair swap spread" is the corporate note spread of the fixed rate payer, less the spread over LIBOR on term borrowing by the floating rate payer.

While a firm's credit rating does affect its attractiveness as a swap counterparty, for single A and better rated firms, cross-sectional ratings differences have no observable impact on quoted swap spreads. Thus, Model T implies that fixed/floating interest rate swaps are mispriced.

B. Mere Institutional Detail: MID Model

In practice swap spreads are not sensitive to credit rating differences between counterparties (at least for entities rated single A or better). Consider a swap between Firm A1 (the fixed rate payer), an A-rated credit, and an AAA Agency (the floating rate payer), an AAA-rated credit that is backed by the full faith and credit of the U.S. Treasury. As before, assume that Firm A1 is able to issue a ten-year bond at Treasuries plus 125 bp and AAA Agency is able to issue a ten-year floater at LIBOR minus 10 bp. It is misleading to view the swap as analogous to the exchange of an A-rated fixed rate bond issued by Firm A1 for a AAA-rated floater issued by AAA Agency. The analogy is misleading because it implies that the "fair" credit adjusted swap rate is the ten-year Treasury rate plus 135 bp. Under this interpretation of a "fair" swap rate Firm A1 would have to pay up an extra 85 bp to do the swap with AAA Agency rather than Firm A2. While AAA entities are more attractive counterparties, A-rated firms do not usually pay up to do business with AAA-rated entities.

There are four reasons why swap rates are not credit sensitive. First, an initial exchange of fixed and floating rate notes which allows either counterparty to sell the other counterparty's note in the secondary market is not identical to the same initial exchange which requires each counterparty to hold the other counterparty's note until maturity. Pricing the notes as stand alone obligations implicitly assumes the former. While swaps may be assigned to acceptable credits, the receive side of a swap cannot be bifurcated and separately sold in the secondary markets. Thus, the latter is more analogous to an interest rate swap. In the United States the value of a note is determined in bankruptcy by accelerating the claim, which in effect sets value at the note's face amount (accreted value for a zero coupon note) no matter how much interest rates have changed since the note was originally issued. Of course, the actual value received could be a small fraction of that amount. Merton (1976) and Geske (1978) view corporate note spreads as compensation for the implicit compound put option that noteholders are writing. Consider a single class of debt and assume that the rule of absolute priority is followed in bankruptcy. If the value of the firm as a going concern exceeds its current interest or principal payment obligation, the payment will be made, otherwise the firm will be put to noteholders. Thus, the firm's note spread is an increasing function of both the debt equity ratio and the variance of the rate of return on total market value.

Now consider an exchange of two debt instruments that cannot be separately sold in the secondary market. In the United States bankruptcy results in a netting of the accelerated claims associated with the floating and the fixed rate notes. The net claim based on offsetting equal face amounts of fixed and floating rate notes is zero and does not depend upon changes in interest rates from the time the transaction was initiated. In our example, if Firm A1 were to go bankrupt and term interest rates have risen since the swap was initiated, AAA Agency would benefit from the resulting netting of the notes.

Conversely, if Firm A1 were to go bankrupt and interest rates have fallen since the swap was initiated, AAA Agency would lose from the resulting netting of the claims. However, in either case the net claim in bankruptcy is zero. In effect, AAA Agency's net position is analogous to an exchange of default-free notes combined with holding a put swaption (the option to pay fixed and receive floating on a swap) conditional on Firm A1 going bankrupt and writing a call swaption (an option to receive fixed and pay floating on a swap) conditional on Firm A1 going bankrupt. If bankruptcy is independent of interest rate levels, the market values of the conditional put and call swaptions will be equal and the swap rate will be dependent on neither the debt equity ratio nor volatility of the return on total market value. However, if low interest rates and bankruptcies are associated with recessionary conditions then the market value of the conditional put swaption will exceed the market value of the conditional call swaption and the initial swap rate will be an increasing function of both the debt equity ratio and the volatility of the return on total market value.

Second, the treatment of swaps in the event of bankruptcy is asymmetric and differs from the treatment of offsetting fixed and floating debt obligations. In contrast to the netting of the face value of offsetting notes, for an interest rate swap the bankruptcy code supports the industry practice of determining the settlement amount for early termination. Under standard swap documentation supported by the International Swap Dealers Association (ISDA), bankruptcy is an automatic default event. The payment due the solvent party is the higher of the market value of its position based on prevailing swap rates or zero. That is, if the market value of the position of the insolvent party is positive its claim is zero. If the market value of the position of the insolvent party is negative, that amount represents the claim of the solvent firm in the bankruptcy proceeding or the claim against which any collateral may be netted. The ISDA provision permitting termination without payment if the market value of the solvent counterparty's position is negative has not been subject to a court challenge. In practice, most solvent counterparties have either voluntarily made the payments or settled out of court. Stronger corporate credits frequently negotiated the removal of this provision from their master swap agreements with swap dealers.

If swap rates have risen, the market value of the swap is positive to the fixed rate payer and negative to the floating rate payer and vice versa. Most swap dealers value a simple fixed/floating swap by: (1) assuming that a LIBOR flat floater sells for par, (2) assuming that a bond having a coupon equal to the swap rate also sells for par, and (3) valuing the difference from the current swap rate as an annuity. The valuation of this annuity for our example requires an estimate of the ten-year zero swap rate, which in turn requires a term structure model to interpolate zero swap rates that are not actively quoted from quoted par swap rates.

While the determination of the value of the swap is based on direct market determination, the actual quotes provided by dealers are based on their proprietary term structure models as well as their existing swap positions.

Under standard International Swap Dealers Association (ISDA) swap documentation, the "market quotation" is determined by the solvent counterparty obtaining the market quotes from swap dealers for replacing the insolvent swap counterparty. The solvent swap counterparty obtains three or more market quotes and the "market quotation" is the truncated average disregarding the highest and lowest quotes. The "settlement amount" is the higher of the market quotation or zero. In Appendix A, the relevant sections of the standard ISDA swap documentation are quoted. These sections describe the procedure for obtaining the market quotations and for calculating the settlement amount.

The asymmetric treatment of the solvent and the insolvent parties under a default event partially offsets the need for credit-sensitive swap spreads. The asymmetric determination of the settlement amount is favorable to the stronger counterparty. However, the impact of this provision is diluted by three factors: (1) the ability of a counterparty to assign a profitable swap prior to a default event, (2) the realization of only a fraction of any positive ISDA settlement amount in a bankruptcy proceedings, and (3) the tendency of solvent counterparties to make at least partial payment for any negative market quotation to avoid litigation.

Third, long-term swaps with maturities in excess of ten years generally contain credit triggers. A typical credit trigger specifies that if either counterparty falls below investment grade (BBB), the other counterparty has the right to have the swap cash-settled at the settlement amount based on the market quotation obtained by the investment grade credit to take the place of the "fallen angel." Investment grade credits very rarely go bankrupt prior to being downgraded. Thus, credit triggers offer substantial protection to both swap counterparties. However, if the investment grade credit's position has a negative value, it may choose not to terminate the swap, because in the event of a subsequent default it may terminate the swap without payment. Credit triggers, combined with the asymmetric treatment of swaps in bankruptcy, substantially mitigate the potential for large credit losses and, under certain conditions, the expected value of the swap may actually increase to a AAA-rated credit if its swap counterparty were downgraded below investment grade.

Fourth, weaker credits are either simply rejected or required to collateralize swaps, rather than be quoted higher swap spreads. Unlike a collateralized loan where the lender is automatically stayed from liquidating the collateral by the filing of a bankruptcy petition, the collateral supporting a swap may be liquidated and applied by the solvent counterparty to offset a positive settlement amount.

To recapitulate, the unique treatment of swaps under default events is the primary reason why swap rates do not depend on credit ratings and do not display the cyclical behaviors evidenced by single A corporate bond spreads. It is incorrect to view a swap as a exchange of fixed and floating rate bonds. The next section motivates the existence of an active swap market with rational value maximizing participants.

C. Motivation for Entering Into Swaps

C.1. Credit Arbitrage and Zero Sum Game Arguments

Bicksler and Chen (1986) argue that higher quality credits have a comparative advantage in borrowing at fixed rates and lower quality credits have a comparative advantage borrowing at floating rates. They do not distinguish between issuing a floating rate note and rolling over six-month paper. They argue that a swap in which the lower credit pays fixed and the higher credit pays floating reduces the former's long-term fixed borrowing costs and the later's floating borrowing costs.

For AAA-rated entities, such as government agencies, LIBOR spreads on floaters (frequently negative) are often higher than the spreads of their fixed rate borrowing costs over swap rates (frequently negative). For such stellar credits a type of "credit arbitrage" is possible. Consider an AAA-rated government agency that is able to issue at transaction a ten-year fixed rate note at Treasuries plus 30 bp and a ten-year floating rate note at LIBOR minus 10 bp. Assuming that the ten-year swap rate is 50 bp, this AAA Agency is able to issue a ten-year fixed rate note and swap into LIBOR minus 20 bp. This combined transaction creates a synthetic floating rate note at a 10 bp saving over the direct issuance of a ten-year floating rate note. However, the AAA Agency savings on the synthetic floater is achieved at the expense of a credit exposure to its swap counterparty.

Turnbull (1987) argues that unless there are externalities such as an incomplete market, swaps are a zero sum game and not all parties can benefit from a swap. This suggests that if the AAA Agency were to enter into such a swap it would incur a substantial economic loss. That is, Firm A1's cost of ten-year fixed rate borrowing is Treasuries plus 125 bp and AAA Agency's cost of ten-year floating rate borrowing is LIBOR minus 10 bp. This suggests that rather than saving 10 bp, on a risk adjusted basis Agency AAA is losing 85 bp.

C.2. Motivation for Borrowing Short and Swapping into Fixed

Arak, Estrella, Goodman and Silver (1988) provide a theory that suggests that interest rate swaps are not redundant securities. They concur with Turnbull's view that a floater combined with a fixed/floating swap is equivalent to fixed rate borrowing and Wall and Pringle's (1987) conclusions concerning the differences between a floater and rolling over short-term borrowing. However, they provide a motivation for firms desiring long-term fixed rate financing to borrow short and swap into fixed. In our example, Firm A1 may still achieve the 75 bp savings if it rolls over short-term borrowings, swaps into fixed and remains a LIBOR flat borrower for the next decade. Arak et al. (1988) note that such synthetic borrowing has a variable credit spread that reflects the impact of potential downgrades (upgrades) on future borrowing costs relative to LIBOR. They argue that a firm will choose to borrow short and swap into fixed rather than borrowing fixed, if its "expecta-

tion of its future credit spreads are lower than the market's" and it is no more "risk averse than the market with respect to its credit spread." The Arak et al. (1988) paper provides an economic motivation for a firm to pay fixed and receive floating. They do not consider the complication of their analysis for credit quality signaling.

Under information asymmetries, it is reasonable to conjecture that Firm A1 has more accurate information about its future credit prospects than investors. If Firm A1 accesses its credit prospects more favorably than investors, it may choose to roll over short-term borrowing and swap into a fixed rate. To this point the analysis is similar to Arak et al. (1988). If it assesses its credit prospects less favorably than investors, it may choose to simply issue a ten-year fixed rate note. If conditions for a separating signalling equilibrium are met, then Firm A1's choice of short-term borrowing combined with a swap signals favorable information about its future credit prospects to investors. The cost of a false signal is a higher expected short-term borrowing cost than could have been achieved had a fixed rate bond been issued directly. Conversely, its choice of conventional fixed rate financing signals less favorable credit prospects. This suggests that synthetic fixed rate financing enhances investors' perceptions of the firm's future credit prospects and lowers the cost of other forms of financing. The growth in the use of swaps over the last decade may be partially attributed to their usefulness in signalling favorable future credit prospects to investors. Thus, the credit signalling argument complements the motive that AEGS provide for firms engaging in synthetic fixed rate financing.

C.3. Motivation for Borrowing Long and Swapping into Floating

The motivation for high credit quality entities to establish pay positions with lesser credits relates to the treatment of swaps in the event of default. The treatment of this issue has been discussed thoroughly in Section IB. Institutional and legal considerations indicate: (1) that swaps are not analogous to the exchange of fixed and floating rate notes, and (2) that rational value maximizing AAA entities enter swaps with A-rated credits even though swap spreads do not reflect credit rating differences. By limiting the credit exposures to specific firms, a diversified portfolio of swaps with A-rated credits including both pay and receive swap positions should have little risk of a large net credit loss. That is, the gains and losses from early terminations of swaps for default events on pay and receive swap positions would offset each other even in a severe recession. A rational AAA-rated swap dealer that is able to pool its credit exposures should be willing to quote the same swap rates for A-rated, AA-rated and AAA-rated entities. There is likely to be a greater demand for pay positions by A-rated firms. An AAA-rated agency that is unable to adequately diversify credit exposures would rationally avoid exposures to lower rated credits and do swaps exclusively with AAA-rated counterparties. Rational AAA-rated agencies are able to establish receive positions with highly rated swap dealers to reduce their cost of floating rate notes rather than directly undertaking swaps with A-rated

credits. Agencies often issue callable fixed notes and, concurrently with swapping into floating, indirectly sell these calls to swap dealers in the form of call swaptions. The net effect of these transactions is to create synthetic floating rate notes at a cost savings of over 20 bp. The apparent underpricing of these call options may be due to a past history of non-optimal exercises of calls on agency debt.

II. Interest Rate Swaps: Fanciful

More complex interest rate swaps are often difficult for swap dealers to accurately value and hedge. The higher profitability of these swaps to swap dealers is compensation for the higher risk assumed by dealers. It is not possible to discuss every type of unusual interest rate swap, a few examples will provide some insights into the range of possibilities.

A. Zero Coupon Swap

First, consider a ten-year zero swap under which no payments occur until maturity. Firm A1 pays fixed on a zero basis (fixed compounded at fixed) and Firm A2 pays LIBOR compounded at LIBOR. Under Model T, subject to the above discussed caveats for the conventional swaps, the ten-year zero swap may be conceptualized as the exchange of a ten-year-fixed-rate zero coupon bond issued by Firm A1 for a ten-year LIBOR zero floating rate note issued by Firm A2. While ten-year LIBOR zero floaters do not exist, if they were to exist the required premiums over LIBOR would be substantial (i.e., greater than 100 bp). This provides a rationale for the zero swap rate (which is not an actively quoted rate) being substantially lower (100 bp) than the zero coupon bond rate on an A-rated issue. However, Model T predicts that zero swap rates depend on the credit-ratings of the counterparties. Under the MID Model, zero swap rates are substantially below single A bond spreads because of the asymmetric treatment of swaps under default events. Under this model, zero swap rates do not depend upon the credit rating of the counterparties.

Note that both sides of the swap compound to maturity. Firm A1 is able to create a synthetic ten-year financing at 100 bp savings by combining the above described swap with a synthetic LIBOR zero floater. The synthetic LIBOR floater involves Firm A1 issuing short-term LIBOR every six months in increasing amounts to finance the LIBOR interest payments as well as to refinance the initial principal over the next decade. If Firm A1 were to remain a LIBOR flat borrower over this period, the synthetic floater would replicate an actual ten-year zero floater issued at LIBOR flat. Its receipt of the compounded LIBOR payment under the swap would offset the accumulated interest on the synthetic zero floater. The combined swap and synthetic floater would replicate the issuance of a ten-year zero. However, the rate on this synthetic zero would be 100 bp lower than the actual rate where Firm A1 could issue a ten-year fixed-rate zero note. As in the case of a conventional swap, the saving is achieved through the transfer of a portion of the credit

risk from investors to the borrower. If the firm were downgraded, its short-term borrowing costs could be substantially higher than LIBOR.

Superficially, the creation of synthetic fixed-rate zero financing appears easier if the LIBOR side were on a current pay basis. Under these conditions, Firm A1's rollover of six-month LIBOR financing for the next decade, combined with a swap in which it pays fixed on a zero basis and receives LIBOR on a current basis would create synthetic ten-year zero financing. However, Firm A2 would in effect be committing to the forward financing of Firm A1's fixed coupons and would require on incremental lending a forward single A financing rate rather than the lower forward swap rate. Thus, the fixed swap rate for such a hybrid would be substantially higher. Under asymmetric information concerning Firm A1's future credit position, such a hybrid is unlikely. If it were optimal for Firm A1 to assume the risk of its short-term borrowing rate exceeding LIBOR on the original principal amount, it would be optimal for it to assume the same risk on the financing of the coupons. This is consistent with the causal empirical observation that under zero swaps both the fixed and the floating sides compound to maturity. Zero swaps have been consummated with maturities as long as thirty years, often with the compounding of both sides of the swap. Compounding of the floating LIBOR payments greatly reduces the maximum liability of the fixed rate payer at maturity. Otherwise, the compounded interest on the zero side would be huge and would create a potential "crisis at maturity," when the entire compounded interest amount is due. Furthermore, the asymmetric treatment of swaps under default events is considerably less valuable when there is only a very small probability that the market value of the swap will be positive to the weaker credit.

B. Switch LIBOR

While the yield curve is very steep in the United States, it is relatively flat or even has downward sloping segments in other countries such as Japan, Germany, and Switzerland. International differences in the shape of the yield curve make "switch LIBOR swaps" attractive to certain investors. These swaps allow an institutional investor to achieve a current yield pick-up while taking a position consistent with its forecasts concerning the direction of future differences in short-term interest rates between two countries such as the United States and Japan. These trades only exist because firms have forecasts of future differentials in short-term rates between these countries that diverge from the corresponding forward rates implied by the countries' yield curves.

Japanese life insurance companies have been major players in this market. Japanese life insurance companies compete with each other based on policyholder dividends. A regulatory law prohibits them from paying dividends out of capital gains and limits their policyholder dividends to current investment income. This creates an incentive for converting capital gains into current income. This was evidenced by the much publicized dividend stripping of years past. However, the Japanese Ministry of Finance (MOF) cured this

symptom and left the regulatory incentive in place. While the cause of this behavior has not been altered, the supply of unrealized capital gains on Japanese equities and real estate holdings of Japanese life insurance companies has been greatly reduced by the performance of those markets. Nevertheless, there is still a desire to create current income. In recent months Japanese yen denominated USD/JPY switch LIBOR swaps have been frequently used to satisfy this desire.

To illustrate a switch LIBOR swap consider a hypothetical Japanese life insurance company, JP Life. Assume that JP Life engages in a three year swap where semi-annually it receives Japanese yen LIBOR and pays U.S. dollar LIBOR plus 40 bp in Japanese yen (i.e., no currency conversion). The six-month LIBOR rates for Japan and the United States are 5.8% and 4.4%, respectively. Thus, the current yield pick-up is 100 bp. This current yield pick-up is made possible by the differences in the slopes of the U.S. dollar and Japanese yen yield curves.

The "fair" spread to add to the U.S. dollar LIBOR rate is defined as the spread that results in the market value of the Japanese yen denominated U.S. dollar LIBOR being equal to the Japanese yen LIBOR payments. Viewing the swap as an exchange of a Japanese yen floater issued by JP Life's counterparty for a Japanese yen floater with coupons indexed to U.S. dollar LIBOR, the "fair" spread is the spread that results in the indexed floater selling for par. A naive approach is to treat the future Japanese yen denominated U.S. dollar LIBOR indexed payments as fixed based on the U.S. dollar LIBOR forwards and to present value these payments using Japanese yen LIBOR zero rates. This approach is correct when U.S. dollar LIBOR rates and JPY/USD exchange rates are uncorrelated. The initial hedge for a Japanese yen denominated U.S. dollar LIBOR payment for a specific semester involves both the purchase of a U.S. dollar LIBOR forward and the purchase of Japanese yen forward. The U.S. dollar LIBOR forward is sized by the Japanese yen notional amount of the swap converted to U.S. dollars at the forward USD/JPY exchange rate: The size of the Japanese yen forward position is the product of the U.S. dollar LIBOR forward rate and Japanese yen notional amount of the swap. An increase (decrease) in the U.S. dollar forward LIBOR rate, holding the exchange rate constant, requires incremental purchases (sales) of Japanese yen to hedge the increased (decreased) amounts of Japanese yen needed for Japanese yen denominated U.S. dollar LIBOR payments. A change in the JPY/USD exchange rate, holding the U.S. dollar LIBOR constant, has no impact on the Japanese yen amounts required to make the Japanese yen denominated U.S. dollar LIBOR payment. It does, however, require an adjustment of the size of the U.S. dollar forward LIBOR position to equal the product of the new USD/JPY exchange rate and the Japanese yen notional amount of the swap.

If the changes in U.S. dollar LIBOR rates were correlated with JPY/USD exchange rates, both the LIBOR and exchange rate hedges would have to take into account the cross partials. Under these conditions the "fair" differential takes into account the covariance between U.S. dollar LIBOR and the JPY/USD exchange rate. That is, the expected value of a product is equal to

the product of the expectations plus the covariance. The "product of the expectations" is equal to the JPY notional amount times the product of the USD LIBOR forward and the USD/JPY forward exchange rate. The "covariance" is equal to the product of the JPY notional amount and the covariance between changes in the forward USD LIBOR rate and the USD/JPY forward exchange rate from now until the date at which the LIBOR rate for that semester's payment is set.

The U.S. dollar value of the amounts is determined by discounting the forward values for each payment date by the U.S. dollar LIBOR zero rates. The Japanese yen value is just the U.S. dollar amount converted to Japanese yen at the spot exchange rate. The sum of the Japanese yen value of the payment and the notional principal amount discounted at the Japanese yen three-year zero-rate is the market value of the Japanese yen denominated U.S. dollar LIBOR indexed floater. If this market value is larger than the notional amount of the swap, the "fair" spread is negative. If this market value is smaller than the notional amount of the swap, the "fair" spread is positive. The "fair" spread is determined as the spread that results in the value of the floater cum LIBOR spread exactly equaling the notional amount of the swap.

The valuation and hedging of a switch LIBOR swap requires estimates of the LIBOR volatility, exchange rate volatility, and the correlation between LIBOR and exchange rate changes. It also requires a model of the multivariate distribution of the term structures in each country and the exchange rate. The LIBOR volatilities may be implied from the pricing of LIBOR caps based on a suitable interest rate option model and/or applying an ARCH or GARCH model to historical interest rate data. Similarly, exchange rate volatilities may be implied from the price of exchange rate options and/or estimated using historical time series data. Such approaches have become fairly common in the derivative products industry. Unfortunately, the estimation of the correlation coefficient is more problematic. There are no options that enable the calculation of implied correlations between interest rates and exchange rates and historical correlations are unstable for many currencies, the U.S. dollar included. This instability is fairly intuitive since the correlation coefficient is strongly influenced by monetary policy. During periods when monetary policy is used to defend the currency against capital outflows, a weakening of the currency may result in increases in short-term interest rates. On the other hand, under a more automatic monetary policy resulting in strong economic activity could cause an increase in interest rates and capital inflows, and a strengthening of the currency. The stability of the correlation depends on the consistency of monetary policy rather than the actual policy employed.

Appendix A

Determination of the Settlement Amount for Early Termination of a Swap in Event of Bankruptcy Based on "ISDA Interest Rate of Currency Exchange Agreement"

Description of ISDA

ISDA is an international group of commercial, investment and merchant banks and others active in swap transactions. Founded in 1985 to promote practices conducive to the efficient conduct of the business of its members and to carry on a dialogue with regulators, it includes over 175 primary and associate members worldwide. The ISDA conventions in effect define the standard industry practice.

Selected Excerpts from ISDA Agreement

(Definition of Bankruptcy as a Default Event)

Events of Default and Termination Events

(a) Events of Default. The occurrence at any time with respect to a party or, if applicable, any Specified Entity of such party, of any of the following events constitutes an event of default (an "Event of Default") with respect to such party.

Bankruptcy. The party or any applicable Specified Entity:

(1) is dissolved: (2) becomes insolvent or fails or is unable or admits in writing its inability generally to pay its debts as they become due: (3) makes a general assignment, arrangement or composition with or for the benefit of its creditors: (4) institutes or has instituted against it a proceeding seeking a judgment of insolvency or bankruptcy or any other relief under any bankruptcy or insolvency law or other similar law affecting creditors' rights, or a petitions presented for the winding-up or liquidation of the party or any such Specified Entity, and, in the case of any such proceeding or petition instituted or presented against it, such proceeding or petition (A) results in a judgment of insolvency or bankruptcy or the entry of an order for relief or the making of an order for the winding-up or liquidation of the party or such Specified Entity or (B) is not dismissed discharged, stayed or restrained in each case within 30 days of the institution or presentation thereof; (5) has a resolution passed for its winding-up or liquidation; (6) seeks or becomes subject to the appointment of an administrator, receiver, trustee, custodian or other similar official for it or for all or substantially all its assets (regardless of how brief such appointment may be, or whether any obligations are promptly assumed by another entity or whether any other event described in this clause (6) has occurred and is continuing): (7) any event occurs with respect to the party or any such Specified Entity which, under the applicable laws of any jurisdiction, has an analogous effect to any of the events specified in clauses (1) to (6) (inclusive); or (8) takes any action in furtherance of, or indicating its consent to, approval of, or acquiescence in, any of the foregoing acts: other than in the case of clause (1) or (5) or, to the extent it relates to those clauses, clause (8), for the purpose of consolidation, amalgamation or merger which would not constitute an event described in (vii) below.

(Right of Solvent Party to Terminate Swap Following a Default Event and Specification of Bankruptcy as Automatic Default Event)

Early Termination

(a) Right to Terminate Following Event of Default. If at any time an Event of Default with respect to a party (the "Defaulting Party") has occurred and is then continuing, the other party may, by not more than 20 days notice to the Defaulting Party specifying the relevant Event of Default, designate a day not earlier than the day such notice is effective as an Early Termination Date in respect of all outstanding Swap Transactions. However, an Early Termination Date will be deemed to have occurred in respect of all Swap Transactions immediately upon the occurrence of any Event of Default specified in Section 5 (a) (vii) (1), (2), (3), (5), (6), (7) or (8) and as of the time immediately preceding the institution of the relevant proceeding or the presentation of the relevant petition upon the occurrence of any Event of Default specified in Section 5(a) (vii) (4).

(Determination of Payments for Early Termination Based on Default Event)

Payments on Early Termination

(i) Defaulting Party or One Affected Party. If notice is given designating an Early Termination Date or if an Early Termination Date is deemed to occur and there is a Defaulting Party or only one Affected Party, the other party will determine the Settlement Amount in respect of the Terminated Transactions and:—

(1) if there is a Defaulting Party, the Defaulting Party will pay to he other party the excess, if a positive number, of (A) the sum of such Settlement Amount and the Termination Currency Equivalent of the Unpaid Amounts owing to the other party over (B) the Termination Currency Equivalent of the Unpaid Amounts owing to the Defaulting Party.

(Determination of Payments for Early Termination by Affected Party Under a Credit Trigger)

(2) if there is an Affected Party, the payment to be made will be equal to (A) the sum of such Settlement Amount and the Termination Currency Equivalent of the Unpaid Amounts owing to the party determining the Settlement Amount ("X") less (B) the Termination Currency Equivalent of the Unpaid Amounts owing to the party not determining the Settlement Amount ("Y")

(Definition Relevant to Determination of Early Termination Payments)

14. Definitions

As used in this Agreement:

"Market Quotation" means, with respect to a Terminated Transaction and

a party to such Terminated Transaction making the determination, an amount (which may be negative determined on the basis of quotations from Reference Market-makers for the amount that would be or would have been payable on the relevant Early Termination Date, either by the party to the Terminated Transaction making the determination (to be expressed as a positive amount) or to such party (to be expressed as a negative among), in consideration of an agreement between such party and the quoting Reference Market-maker and subject to such documentation as they may in good faith agree, with the relevant Early Termination Date as the date of commencement of such agreement (or, if later, the date specified as the effective date of such Terminated Transaction in the relevant Confirmation), that would have the effect of preserving for such party the economic equivalent of the payment obligations of the parties under Section 2(a) (i) in respect of such Terminated Transaction that would, but for the occurrence of the relevant Early Termination Date, fall due after such Early Termination Date (excluding any Unpaid Amounts in respect of such Terminated Transaction but including, without limitation, any amounts that would, but for the occurrence of the relevant Early Termination Date, have been payable (assuming each applicable condition precedent had been satisfied) after such early Termination Date by reference to any period in which such Early Termination Date occurs). The party making the determination (or its agent) will request each Reference Market-maker to provide its quotation to the extent practicable as of the same time (without regard to different time zones) on the relevant Early Termination Date (or, if an Early Termination Date is deemed to occur, as of a time as soon thereafter as practicable). The times as of which such quotations are to be obtained will, if only one party is obliged to make a determination under Section 6(e), be selected in good faith by that party and otherwise will be agreed by the parties. If more than three such quotations are provided, the Market Quotation will be the arithmetic mean of the Termination Currency Equivalent of the quotations, without regard to the quotations having the highest and lowest values. If exactly three such quotations are provided, the Market Quotation will be the quotation remaining after disregarding the quotations having the highest and lowest values. If fewer than three quotations are provided, it will be deemed that the Market Quotation in respect of such Terminated Transaction cannot be determined.

"Settlement Amount" means, with respect to a party and any Early Termination Date, the sum of:-

(a) the Termination Currency Equivalent of the Market Quotation (whether positive or negative) for each Terminated Transaction for which a Market Quotation is determined; and
(b) for each Terminated Transaction for which a Market Quotation is not, or cannot be, determined, the Termination Currency Equivalent of such party's Loss (whether positive or negative);

provided that if the parties agree that an amount may be payable under Section 6(e) to a Defaulting Party by the other party, no account shall be taken of a Settlement Amount expressed as a negative number.

Appendix B

Selected Excerpts from Bankruptcy Code (Added Notations in Bold)

Section 101 (11 U.S.C. #560)

((55) defines a "swap agreement" and (56) defines a "swap participant.")

(55)* "swap agreement" means—

(A) an agreement (including terms and conditions incorporated by reference therein) which is a rate swap agreement, basis swap, forward rate agreement, commodity swap, interest rate option, forward foreign exchange agreement, rate cap agreement, rate floor agreement, rate collar agreement, currency swap agreement, cross-currency rate swap agreement, currency option, any other similar agreement (including any option to enter into any of the foregoing);

(B) any combination of the foregoing; or

(C) a master agreement for any of the foregoing together with all supplements;

(56)* "swap participant" means an entity that, at any time before the filing of the petition, has an outstanding swap agreement with the debtor; . . .

Section 362 (11 U.S.C. #362)

(#362 (a) (5) and (6) deals with an automatic stay on the exercise of liens against debtors that comes into effect when a bankruptcy occurs.)

#362. Automatic stay.

(a) Except as provided in subsection (b) of this section, a petition filed under section 301, 302, or 303 of this title, or an application filed under section 5(a) (3) of the Securities Investor Protection ct of 1970 (15 U.S.C. 78eee(a) (3)), operates as a stay applicable to all entities, of —. . .

(5) any act to create, perfect, or enforce against property of the debtor any lien to the extent that such lien secures a claim that arose before the commencement of the case under this title; . . .

(7) the setoff of any debt owing to the debtor that arose before the commencement of the case under this title against any claim against the debtor; . . .

(#362(b) (14) deals with the exemption of swaps from the automatic stay on the exercise of liens against debtors that comes into effect when a bankruptcy occurs.)

(b) The filing of a petition under section 301, 302, or 303 of this title, or of an application under section 5(a) (8) of the Securities Investor

Protection Act of 1970 (15 U.S.C. 78eee(a) (8), does not operate as a stay— . . .

(14) under subsection (a) of this section, of the setoff by a swap participant, of any mutual debt and claim under or in connection with any swap agreement that constitutes the setoff of a claim against the debtor for any payment due from the debtor under or in connection with any swap agreement against any payment due to the debtor from the swap participant under or in connection with any swap agreement or against cash, securities, or other property of the debtor held by or due from such swap participant to guarantee, secure or settle any swap agreement.

Section 546 (11 U.S.C. #546)

(#546 deals with limitations on the powers of bankruptcy trustees to avoid transfers made prior to the bankruptcy filing, and #546 (g) explicitly deals with swaps.)

(g) Notwithstanding sections 544, 545, 547, 548(a) (2) and 548(b) of this title, the trustee may not avoid a transfer under a swap agreement, made by or to a swap participant, on connection with a swap agreement and that is made before the commencement of the case, except under section 548(a) (1) of this title.

Section 560 (11 U.S.C. #560)

(#560 deals with the contractual right to terminate a swap and the reliance on normal business practice.)

#560. Contractual right to terminate a swap agreement.

The exercise of any contractual right of any swap participant to cause the termination of a swap agreement because of a condition of the kind specified in section 365(e) (1) of this title or to offset or net out any termination values or payment amounts arising under or in connection with any swap agreement shall not be stayed, avoided, or otherwise limited by operation of any provision of this title or by order of a court or administrative agency in any proceeding under this title. As used in this section, the term "contractual right" includes a right, whether or not evidenced in writing, arising under common law, under law merchant, or by reason of normal business practice.

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