Goldman, Sachs & Co. Nikkei Put Warrants –1989

Bankers at Goldman, Sachs & Co. were busy in November and December 1989 as they moved closer toward announcing a new product that would allow American retail investors to bet against the nearly unstoppable rise in the Japanese stock market. The Goldman Sachs team had been working since spring 1988 to design and bring to market a product they thought would be of great interest to American investors—exchange-traded put warrants on Japan's Nikkei 225 Stock Average. By December 1989 the product design was ready, but the team had to set the price at which the Nikkei put warrants (NPWs) would be offered to the public. The ultimate success of the product launch would depend on the market's reaction to the offering, which in turn would depend on the price that was set.

Prelude to Nikkei Put Warrants

Put options give their holders the right, but not the obligation, to sell an underlying asset by a certain date for a predetermined price. In the case of the NPWs, the underlying asset that investors could sell was the Nikkei 225 Stock Average. Comparable to the Dow Jones Industrial Index in the United States, the Nikkei 225 Stock Average was a broad-based, price-weighted index of the 225 largest stocks trading on the Tokyo Stock Exchange.[1] NPWs would enable investors to profit from a decline in the Nikkei index while exposing them to limited risk from rises in the index. If brought to market, the NPWs would be the first securities listed on a U.S. exchange and available to retail investors explicitly permitting investors to speculate on or hedge against falls in the Nikkei index.

Goldman Sachs first sensed U.S investors' demands for Nikkei put warrants in mid-1987. On June 10 of that year, Bear Stearns had underwritten a public offering of currency warrants issued by General Electric Credit Corporation and listed on the American Stock Exchange. These warrants entitled the investor to sell yen to the issuer at any time within 2 years at a fixed exchange rate. The currency warrants appealed to retail investors who had few other opportunities to purchase long-dated

1. In a price-weighted index like the Dow Jones Industrial Index or the Nikkei 225 Stock Average, each stock contributes to the index based on its per-share price. In contrast, in a value-weighted index like the Standard & Poor's 500 index, each stock contributes to the index based on its total market capitalization.

Peter Tufano prepared this case as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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currency options. The initial offering was apparently heavily subscribed. The deal was carefully scrutinized by rival investment banks, and Morgan Stanley offered a similar product within days. By June 22, Goldman Sachs became the third investment bank to launch an offering of currency warrants, as an underwriter for Citicorp. In the Citicorp transition, as in the other deals, the issuer simultaneously offered the warrants to the public and entered into an exactly offsetting option contract with the investment bank involved. Thus, the corporate issuers of the currency warrants were completely insulated from exchange rate risk and, in effect, earned a fee for facilitating the transaction.

The experience of selling exchange-listed currency warrants made three important impressions on the Goldman Sachs team. First, sales force reports made clear that while investors were interested in puts on the yen, puts on the Nikkei would be much more widely demanded. Second, the product concept seemed to show that there were profits to be made from buying options (called "sourcing volatility") in institutional markets and reselling them to retail customers who were unable to buy the large lot-sized institutional deals. Third, their experience with currency warrants persuaded the team that new markets could quickly become satiated. The Citicorp currency warrants deal, although it was only the fourth to come to market, was difficult to place. In addition, the prices of the currency warrants fell quickly from the initial deal levels. **Exhibit 1** shows the implied volatilities of the first currency warrants brought to market.[2]

In 1987 selling exchange-listed put warrants on the Nikkei 225 Stock Average seemed a remote possibility. The Japanese Ministry of Finance did not support this idea and through a variety of direct and indirect channels could effectively veto any proposal to sell puts on the Nikkei. Perhaps more important, Goldman Sachs had no readily available liquid source of puts they could use to hedge or produce the put contracts.

In spring 1988 the Goldman Sachs capital markets group in Tokyo began to hear rumors that someone was willing to sell put options on the Nikkei. Soon thereafter, *International Financing Review*, a trade publication that tracked world financial markets, reported the first of a series of recent Eurobonds whose redemption values at maturity were tied to the level of the Nikkei 225 Stock Average.

These Euro-yen bonds became a source of puts that could be sold to institutional and retail accounts. **Exhibit 2** provides data on two representative Nikkei-linked Euro-yen offerings issued in mid-December 1989.

The typical issuers of Nikkei-linked bonds were non-Japanese financial institutions. **Exhibit 3** shows the related contracts into which a hypothetical Nikkei-linked bond issuer might enter. It sold a bond that promised to make annual interest payments in yen at a fixed interest rate. However, through a set of swaps, the issuer transformed its annual fixed-rate yen payments into dollar-denominated LIBOR-based payments.[3]

At maturity, the issuer would redeem the bonds from the investor at a price tied to the Nikkei. If the Nikkei fell since the bonds were issued, the issuer would pay less than par to redeem the bonds. Thus, it would be as if the issuer sold bonds with final principal payments at par but also bought a put option on the Nikkei maturing in the same year as the bond. If the Nikkei fell, the put would rise in value, benefiting the issuer.

2. Implied volatilities, which can be backed out of option prices given a model such as the Black-Scholes model, reflect the market's estimate of the dispersion of future outcomes, in this case of future exchange rates.
3. LIBOR is the London Interbank Offered Rate, which often served as the benchmark in the Euromarkets for floating-rate note issues.

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Usually, the issuer had no interest in holding this embedded Nikkei put. However, it could, and often did, resell the embedded put options to financial intermediaries like Goldman Sachs by promising to deliver, at maturity, the difference between the bond's par value and its Nikkei-linked redemption price. In the Skopbank example in **Exhibit 2**, if the Nikkei fell to 23,000 in 1 year, Skopbank would not be required to make any principal payments to the holders of its notes. However, if it had sold the embedded put to a financial institution, it would be required to deliver the difference between par and its required payment to its bondholders (in this case, ¥ 6.7 billion) to the buyer of the put at the end of 1 year. In exchange for promising to make this payment, which equaled the intrinsic value of the embedded put, the bond issuer would be paid an up-front put premium.[4]

Japanese financial institutions bought the Nikkei-linked Eurobonds. Based on administrative guidelines set by the Ministry of Finance, Japanese life insurers were permitted to pay dividends out of interest income but not from capital gains. Payment of dividends was perceived to be an important competitive action in the insurance industry in Japan, and the high-coupon, yen-denominated bonds gave life insurers enhanced interest income to support dividend payments. In exchange for receiving enhanced interest income, the institutions were willing to risk capital losses on their principal value if the Nikkei fell.

Investment banks, such as Goldman Sachs, that executed Euro-yen Nikkei-linked transactions had a ready source of Nikkei puts bought from the issuers of the bonds. These put contracts could be held by the firm in inventory. Alternatively, they could be resold to institutional investors in the form of over-the-counter (OTC) put warrants by writing offsetting contracts against the puts purchased from Euro-yen bond issuers. OTC puts thus often had the exact features of the puts the banks had purchased; hence, they were typically unlisted, European-style options, paid off in yen, and sold in large denominations. As of early December 1989, Goldman Sachs' trading and arbitrage division, a unit of the equity securities area, could buy 3-year, yen-denominated put options on the Nikkei from bond issuers and resell them to institutions at implied volatilities of about 13.6%.

The firm did not sell all its Nikkei puts in the form of OTC puts to institutional customers. As of December 1989, Goldman Sachs had a significant inventory of European-style puts on the Nikkei, and the proposed NPW transaction could use as much as half of that inventory. The firm mitigated most, but not all, of its risk in holding these puts by taking offsetting futures positions in the Nikkei futures contracts offered by the Singapore, Osaka, and Tokyo stock exchanges. As a policy matter, Goldman Sachs chose to hold a small amount of the puts without direct offsetting positions in order to hedge the firm's overall exposure to the Japanese securities business and to the global securities business that was related to the performance of the Japanese stock market.

Given the sales force feedback from its 1987 currency warrant experience, and the new supply of Nikkei puts, the capital markets group, a unit of the investment banking area at Goldman Sachs, began to consider the possibility of selling exchange-listed NPWs. To bring exchange-listed Nikkei put warrants to market, many different activities within and outside Goldman Sachs needed to be coordinated. The NPW team needed to design the contract, produce the analysis to demonstrate the product's feasibility, and assemble marketing documents. They needed to test the concept internally with sales, research, and capital markets staff. Regulators in both the United States and Japan needed to approve the plan, because it would involve selling a Nikkei-linked, U.S. exchange-listed security.

4. In practice, the bond issuer would pay the put premium to its swap counterparty to compensate it for making an attractive sub-LIBOR swap. In other words, the up-front put premium has the effect of reducing the annual floating coupon the issuer would pay on its bond-plus-swap package.

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Goldman Sachs needed to work with the exchange where the puts would be listed, in this case, the American Stock Exchange. The trading and arbitrage division had to be able and willing to sell the puts and to construct any currency hedge that might be needed. Senior management had to approve the plan.

Design of NPWs

In their simplest form, NPWs would merely allow investors to profit from declines in the Nikkei index while limiting their risk from increases in the index. However, in bringing the product to market, a number of specific design issues needed to be resolved, with concern both for investor preferences and for Goldman Sachs' ability to produce the warrants. Key contract features that needed to be set included the following:

1. *American- vs. European-style option*. With an American-style option, the holder can exercise the option on or before the expiration date, but with a European-style option the holder can exercise the option only on the expiration date. The raw material from which the puts were constructed tended to be European-style options. However, the sales staff noted that U.S. investors were more comfortable with American-style options, and therefore the design team decided that the NPWs would be American-style.

2. *Length of contract (expiration date)*. In theory, the expiration date of the warrants could be set at any date. The American Stock Exchange had expressed a preference that the warrants have lives as long as possible, but in any event not less than 1 year long, in contrast with the shorter-term options typically offered by the Chicago exchanges. Goldman Sachs' trading and arbitrage division had puts in inventory with maturities typically under 4 years. The final decision was to set a 3-year life.

3. *Treatment of exchange-rate risk*. The Nikkei is denominated in yen, and Nikkei-linked Eurobonds and the OTC puts all pay off at exercise in yen. The retail NPW product could be written so that the strike price, and thus the payoff, would be calculated in yen and the payoff converted to dollars at exchange rate at the exercise or maturity date. However, this arrangement would force U.S. investors to directly bear movements in the exchange rate. A second alternative would be to fix the exchange rate at the outset of the contract and to use that fixed exchange rate to translate yen payoffs into dollars at exercise or maturity. A third alternative would be to set the exercise price in dollars and calculate the payoff as the difference between this fixed-dollar exercise price and the level of the Nikkei translated into dollars at the exchange rate at the time of exercise or maturity. The sales staff felt that U.S. investors would prefer the second of these alternatives.

4. *Treatment of contract rights in the case of extraordinary events.* The Nikkei-linked bonds and OTC puts contained provisions for settlement in the event that the Tokyo Stock Exchange closed, or if war or natural disaster materially and adversely affected the Japanese economy. The NPW contract needed to specify how investors' claims would be settled in these instances.

5. *Size of offering and per warrant size*. Because the NPWs were designed for individual investors, it was important that they be sold in relatively small lot sizes, in contrast to OTC puts, which required minimum investments of $250,000. At the same time, the

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> Goldman Sachs team sought to keep the per warrant price above $5.00 because below this level the contracts would not be eligible for short sales on the American Stock Exchange. To accomplish these objectives, the proposed NPW contract gave holders one-fifth of an option on the value of the Nikkei. The team expected to offer 9.5 million warrant contracts in the first one or two offerings.

Throughout the fall of 1989, Goldman Sachs had been working with officials at the American Stock Exchange to bring the Nikkei put warrant offering to market. A key roadblock to actually issuing the warrants was the Japanese Ministry of Finance, which had not yet approved the put warrants. The American and Tokyo stock exchanges had an information-sharing or "mutual surveillance" agreement. Under the terms of this agreement, the Tokyo Stock Exchange effectively was given the right to veto the American exchange listing of Nikkei-linked instruments. On Friday, December 15, 1989, officials at the American Stock Exchange finally received approval to list the Nikkei warrants.

In addition, Goldman Sachs would need to find an issuer for the warrants. As a private partnership and a non-SEC registrant the firm could not issue the warrants publicly without making material public disclosures. Therefore, it was imperative that it be able to work with an issuer registered with the SEC. Specifically, as in the currency warrant transactions, the issuer would sell the warrants to the public but simultaneously enter into a private contract with Goldman Sachs that exactly offset the obligation under the warrant contract. In return, the issuer effectively would receive a fee from Goldman Sachs but economically would have no Nikkei exposure. For accounting purposes, U.S. corporate issuers would be exposed to adverse reporting implications because they would not be allowed to cancel out the warrant transactions for financial reporting.[5] Therefore, the team felt that the most likely issuers were highly creditworthy, non-U.S. sovereign entities with broad name recognition among U.S. retail investors. Goldman Sachs had entered into a tentative agreement with the Kingdom of Denmark to issue the NPWs and to buy an exactly offsetting contract from Goldman Sachs. The Kingdom of Denmark would net approximately $1.3 million for executing these transactions.

To sell the amount of warrants it hoped to offer, Goldman Sachs, felt that it was appropriate to increase its retail distribution capacity by collaborating with other Wall Street firms. They selected Paine Webber and Dean Witter Reynolds to co-manage the offering because of their strong retail clienteles and because these organizations were not considered to be competitors on the investment banking side of the business. Having co-managers on the deal would also provide additional assurances that the pricing decision would be carefully scrutinized.

Pricing Questions

One key question that needed to be resolved was how to price the NPWs. The Goldman Sachs team spent many hours collecting the information they would need and discussing how to set the right price for the product. The higher the price they set—assuming that the market bought the product at that price--the larger the profits to Goldman Sachs. However, if the price was too high, the firm could find itself with an unsold inventory of NPWs. In addition, competitors could copy the NPW structure, price their warrants lower, and have a more successful launch. More important, if the first deal was priced too high and the NPWs traded down in the secondary market, both investors and the issuer (the Kingdom of

5. The warrants would give rise to a liability (the obligation to buy the Nikkei from the investors) and a simultaneous asset (the put purchased from Goldman Sachs). While economically, these offsetting obligations would leave the issuer with a pefectly hedged position, for accounting purposes the set of transactions would appear to show an increase in leverage for the firm.

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Denmark) would be displeased with the outcome. Goldman Sachs' reputation, which was highly valued at the firm, could be tarnished by a well-publicized poor showing for this new product.

The sales staff had been instrumental in guiding the product team by conveying their perceptions of the market's preferences for the features of the NPW. However, the sales staff was less informative about the price the market would bear. Thus, the product team had to arrive at a price by thorough analysis and a well-informed guess.

Costs

One factor the group needed to consider was the lower boundary of pricing—Goldman Sachs' break even. For an offering of the size planned, direct costs, other than the fee to the issuer, included legal and listing fees projected to be about $350,000. Selling concessions (commissions) would total about $3 million, much of which would leave Goldman Sachs because its co-managers, Paine Webber and Dean Witter Reynolds, were expected to sell much of the deal. As noted earlier, the Kingdom of Denmark would also be paid a fee of $1.3 million. The team discussed how they should think about the costs of R & D time and effort, which consumed nearly 2 calendar-years and 10 person-years.

The largest cost components were clearly the costs of hedging, or producing the NPWs. The firm planned to buy American-style at-the-money 3-year yen-denominated puts from Goldman Sachs' trading and arbitrage area. Currently they could buy those puts with an implied volatility of about 13.6% per year. Having purchased them, the firm would still need to hedge its currency risk, which would not be a trivial task.

The proposed NPWs would pay investors dollars, with the exchange rate to be used at the time of exercise set at the time of the offering. The puts that the trading and abitrage division would provide paid off in yen. If this yen payoff at maturity were known with certainty, the firm could buy a forward contract on dollars to ensure that it could meet its obligation to the holders. However, neither the size nor timing of the firm's need for dollars was known. Early exercise or extraordinary events could lead to immediate needs to settle the contracts and deliver dollars. More important, drops in the Nikkei along with the appreciation of the dollar would require the firm to deliver more dollars and expose the firm, if unhedged, to losses on the transaction. In the 1980s, the Nikkei and the yen/dollar exchange rate tended to move in opposite directions. Decreases in the Nikkei tended to be associated with slight increases in the yen/dollar exchange rate, or with an appreciation of the dollar.[6]

The J. Aron currency and commodity division of Goldman Sachs offered a product called QUANTOS™ to its customers to solve the type of dynamic currency hedging problem the firm would

6. Formally, we observe that the covariance of the daily return on the Nikkei average and the daily return to buying yen with dollars has been negative for much of the decade. This covariance is defined as:

$$\mathrm{cov}(N_i, Y_i) = \frac{1}{n}\sum (N_i - \overline{N})(Y_i - \overline{Y}) \quad \text{where}$$

N_i = log(Nikkei$_{\underline{today}}$/Nikkei$_{\underline{yesterday}}$)

$\overline{N}$ = mean of N_i

Y_i = log[(yen/dollar)$_{\underline{today}}$/(yen/dollar)$_{\underline{yesterday}}$]

$\overline{Y}$ = mean of Y_i

n = number of observations

For the period January, 1980 through December 18, 1989, the cov(N_i, Y_i) was -.0000020. For the period January 1989 through December 18, 1989, the cov(N_i, Y_i) was -.0000065.

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face. If Goldman Sachs wanted to hedge out all of the currency risk from its issue of the warrants, it estimated that its hedge would cost approximately $1.00 per warrant to set up. If the company wanted to offset approximately 80% of the exchange rate risk it might bear, it might cost approximately 50 cents per warrant. The imperfect hedge would still leave Goldman Sachs subject to some exchange-rate risk. These estimates of the cost of the hedge were subject to revision, because the actual hedge would be adjusted based on movements in the Nikkei and exchange rates.

Other Pricing Boundaries

No other product provided U.S. retail investors with the package of features available in the proposed NPWs: U.S. exchange listing and liquidity, small denomination, and no currency risk. U.S. citizens could buy futures on the Nikkei trading on Singapore International Monetary Exchange, but these contracts settled in yen and provided no limit to downside risk. The Chicago Mercantile Exchange was gearing up to trade options on Nikkei futures, and the Chicago Board of Trade was planning to trade futures on TOPIX, a broad market capitalization-weighted Japanese stock index, but as of December neither product was traded.

As of December 1989, the closest substitutes for the proposed NPWs were a pair of Nikkei put warrants first offered earlier in 1989 and listed on the Toronto Stock Exchange. The two warrants could be purchased by U. S. citizens 90 days after they were first offered for sale in Canada; therefore by December both could be owned by Americans. Unlike the proposed NPWs, the Canadian warrants paid off in Canadian dollars, not U. S. dollars, and their treatment of exchange rates differed from that proposed by Goldman Sachs. The terms of the Canadian warrants are shown in **Exhibit 5**.

The product team also collected data on the Nikkei, exchange rates, and other relevant capital market data (see **Exhibits 6-9**) and met late in December 1989 to price the proposed transaction.

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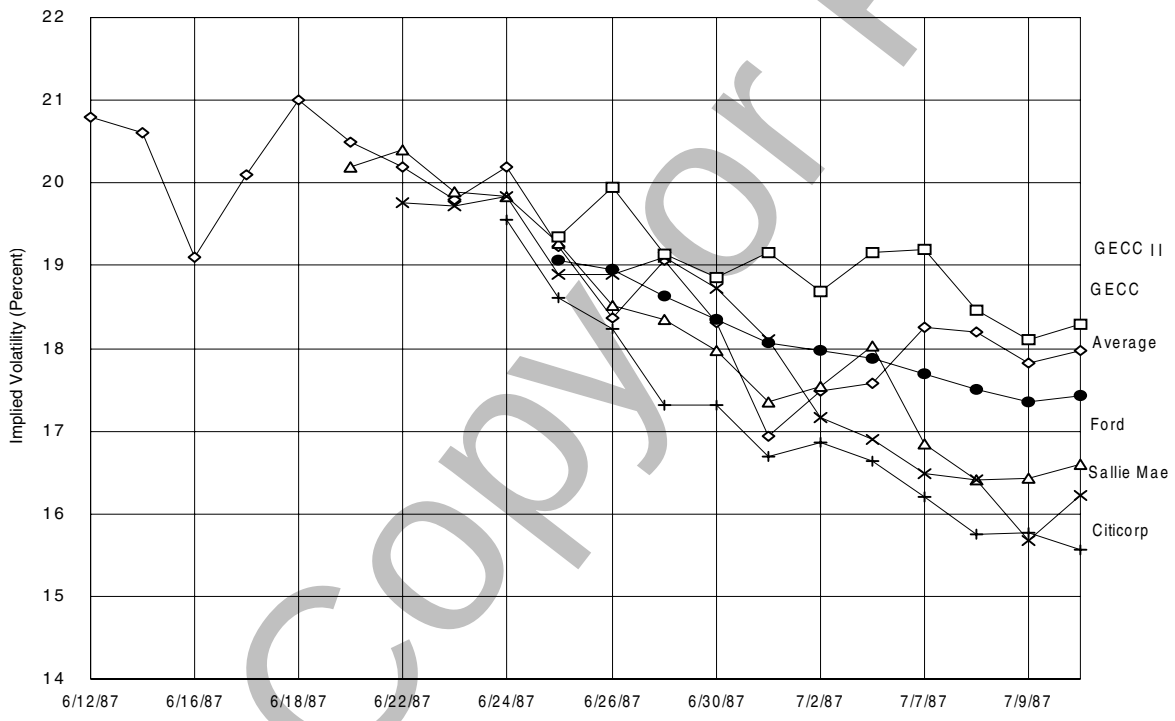
Exhibit 1 Daily Implied Volatilities of Exchange-Listed Yen Currency Warrants



Source: Goldman Sachs & Co.

Note: Implied volatilities represent the market's estimate of the variability in exchange rates inferred from the prices at which the warrants trade. For each warrant, the chart shows the implied volatilities for each of the contracts from the first trading day for that contract.

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Exhibit 2 Representative Nikkei-Linked Euro-Yen Offerings, December 1989

Issuer:	Skopbank
Size of Offering:	¥ 6.7 billion
Coupon:	7%
Maturity:	1 Year
Issue Price:	101 ⅛
Call Options:	None
Denomination:	¥ 100 million
Commissions:	1 ⅛ %
Redemption:	Redemption is linked to the Nikkei 225 Stock Average (N) at maturity by the following formula: If, at maturity, $N \geq 31{,}870.04$, then redemption at par; if $N \leq 23.902.53$, then redemption zero; if in between, then redemption = $¥\ 100\ \text{million} \times \left[1 - \frac{(31{,}870.04 - \text{N}) \times 4}{31{,}870.04}\right]$
Nikkei Level at Issue:	Approximately 38,200

Issuer:	State Bank of South Australia
Size of Offering:	¥ 3.5 billion
Coupon:	1.916667% payable 4/12/90; 5.5833333% payable 1/10/91; 7.5% payable 1/10/92
Maturity:	2 Years (1/10/92)
Issue Price:	101 ⅛
Call Options:	None
Denomination:	¥ 100 million
Commissions:	1 ⅛ %
Redemption:	If at any time during the life of the contract, the Nikkei equals or exceeds 40,930, then redemption at par. Otherwise, redemption is linked to the Nikkei 225 Stock Average (N) at ten days prior to maturity by the following formula: If, at maturity, $N \geq 37{,}724$, then redemption at par; if $N \leq 25{,}149$, then redemption zero; if in between, then redemption = $¥\ 100\ \text{million} \times \left[1 + \frac{(\text{N} - 37{,}724) \times 3}{37{,}724}\right]$
Nikkei Level at Issue:	37,724.

Source: Compiled from *International Financing Review*, December 16, 1989.

Note: *International Financial Review* reported that seasoned Euro-yen bonds yielded 6.10% (1-year maturity), 5.94% (5-year maturity), and 5.58% (10-year maturity) in December 1989. For other capital markets data, see **Exhibit 6**.

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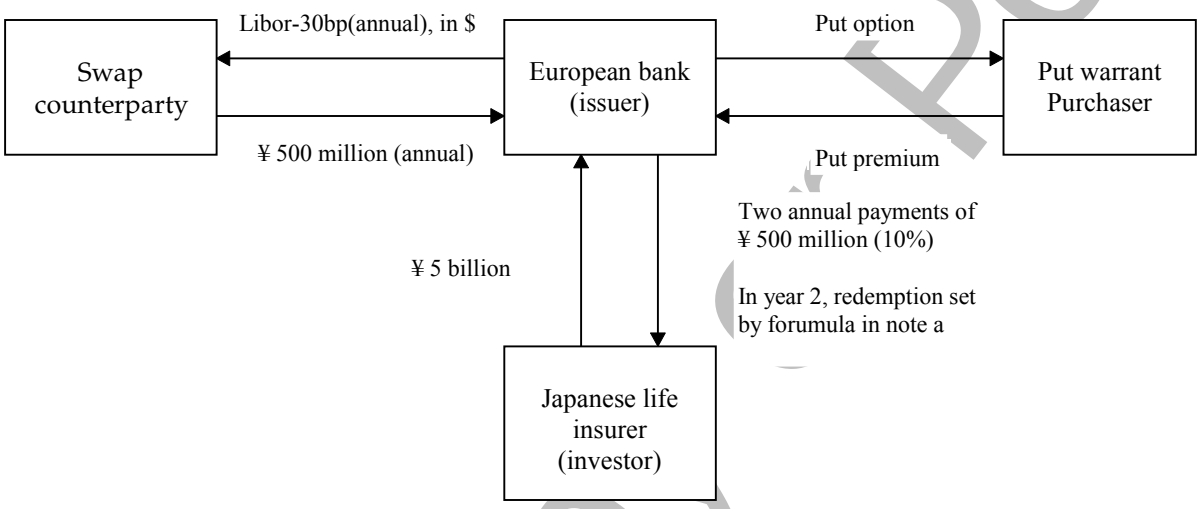
Exhibit 3 Hypothetical Nikkei-Linked Euro-Yen Transactions



Note: bp=basis point, $\frac{1}{100}$ of 1%.

a. At maturity, the bond's redemption value is equal to the following: If Nikkei>38,000, redemption =100%; if Nikkei<25,333, redemption-zero; otherwise, redemption =

$$100\% \times \left[1 - \frac{(38{,}000 - \mathrm{N}) \times 3}{38{,}000}\right]$$ where N=level of Nikkei at maturity.

b. At maturity, the issuer delivers to the put purchaser a payment equal to par less the redemption value of the bond.

c. The bond issuer typically pays the put premium to the swap counterparty in order to compensate them for making a sub-LIBOR swap.

d. For the investor, non-Nikkei-linked fixed-rate yen investments would typically yield 7%. One alternative for the issuer would be to issue 2-year, U.S.-dollar-denominated, floating-rate notes at LIBOR (with no Nikkei-linked feature).

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Exhibit 4 Terms of Proposed Kingdom of Denmark Nikkei Put Warrants

Issuer: Kingdom of Denmark
Date: January 1990.
Amount: 9.5 million warrants.
Expiration: Any date within 36 months of issue.

Cash Settlement Value

The cash settlement value shall be an amount in U.S. dollars of the excess, if any, of (1) the exercise price over (2) the expiration value. The exercise price will equal $N/(5Y)$, where N = closing Nikkei average on the day prior to the issuance of the NPWs, and Y = ¥/$ exchange rate on the day prior to the issuance of the NPWs. The expiration value is one-fifth of the dollar amount obtained by converting the closing value of the Nikkei average on the exercise date into U.S. dollars at a fixed exchange rate equal to Y.

For example, if the deal had been issued on 12/19/89, it would use the prior day's Nikkei level and exchange rate to set the exercise price. On 12/18/89 the Nikkei was 38,586.18 and the exchange rate was 144.28 ¥/$; thus the exercise price would be set at $N/(5Y)$ = (38,586.18)/(5 x 144.28) = $53.49. If an investor later wanted to exercise her option when the Nikkei was 30,000 and the current exchange rate was 115 ¥/$, the expiration value would be 30,000/(5 x 144.28) = $41.59; and the cash settlement value would be $53.49-41.59 = $11.90. It is important to note that the calculation of the expiration value uses the exchange rate in effect on the date when the issue was sold, not the rate in effect when the warrants were exercised.

Because of the time difference between New York and Tokyo, warrants exercised in New York by 3 p.m. will receive a cash settlement value calculated with the Nikkei 225 Stock Average on the close of business on the Tokyo Stock Exchange on the next succeeding business day

Conditional Exercise

Any warrant holder may elect to make the exercise of its warrants contingent on the closing value of the Nikkei average on the exercise date not being more than 500 points above the closing value of the Nikkei average on the relevant notice date.

Limitation Event

All exercises of warrants (other than on the expiration date or the delisting date) are subject, at the Kingdom's option, to the limitation that not more than 2 million warrants in total may be exercised on any exercise date and not more than 500,000 warrants may be exercised by or on behalf of any person or entity, either individually or in concert with any other person or entity, on any exercise date.

Extraordinary Events

Defined as suspension of trading on the Tokyo Stock Exchange, government action that would make the warrants unlawful, or outbreaks of "hostilities or other national or international calamity or crisis . . . which has or will have a material adverse effect on the ability of the Kingdom to perform its obligations under the warrants or to modify the hedge of its position with respect to the Nikkei average."

If the Kingdom determines that an extraordinary event has occurred and is continuing on an exercise date, then the cash settlement value of any warrants that would otherwise be calculated on such day shall be calculated on the next succeeding business day on which there is no extraordinary event, provided that if the cash settlement value of such warrants is not calculated on or prior to the expiration date or the delisting date, then the cash settlement value shall be calculated as if such warrants had been exercised on the expiration date or the delisting date, as the case may be.

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Exhibit 5 Terms of Put Warrants Listed on the Toronto Stock Exchange, 1989

Warrant:	NKP.WT.
Issuer:	BT Bank of Canada.
Date:	February 17, 1989.
Amount:	C$20 million, increased to C$32 million.
Expiry Date:	February 17, 1992.
Type:	American put.
Price at Issue:	C$3.55.
Cash Settlement Value in C$:	$100 \text{ NKP.WT} = 11.68 \times \left[\frac{(32{,}174 - \text{Nikkei at exercise})}{\text{yen / C\$ at exercise}} \right]$

Calculation of Value When Exercised

If exercised by 3 p.m., Toronto time, the contract cash settlement value shall be determined as of close of the following business day in Tokyo.

Limit Option

Any holder has the right to make the exercise of such holder's warrants contingent on the value of the closing quotation for the Nikkei index on the valuation date being not more than 500 Nikkei index points higher than the closing quotation on the relevant notice date. If such contingency is not met, such holder's warrants will be deemed not to have been exercised.

Maximum Exercise of Warrants

In the event that BT Bank determines, on the business day following any notice date, other than the expiration date, that more than 1 million warrants are being exercised by a single holder or a group of holders acting in concert, then BT Bank may deem the valuation date for the first 1 million of the warrants exercised by such holder or group of holders to be the business day next following such notice date and the valuation date for each additional tranche of 1 million of the warrants (or part thereof, in the case of the last tranche) exercised by such holder or group of holders to be each succeeding business day thereafter until all warrants exercised on such notice date by such holder or group of holders have been valued.

Extraordinary Events:

Defined as "any event, circumstance or cause (whether or not reasonably foreseeable) beyond the reasonable control of BT Bank . . . which has or will have a material adverse effect on the ability of BT Bank to perform its obligations or hedge its position with respect to the warrants." These include suspension of trading or limitations of prices on the Tokyo Stock Exchange, suspension of trading on the Nikkei 225 Futures Contracts on SIMEX or Osaka, government action that would "affect payment of amounts due under the warrants," government action that has "material adverse effect on the financial markets of Japan," or "any outbreak or escalation of hostilities or other national or international calamity or crisis." If BT Bank determines that on a valuation date an extraordinary event has occurred and is continuing, then the net cash settlement value shall be calculated on the basis that the valuation date shall be the next business day in which there is no extraordinary event.

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Exhibit 5 (continued) Terms of Put Warrants Listed on the Toronto Stock Exchange, 1989

Warrant:	NKP.WT.A.
Issuer:	BT Bank of Canada.
Date:	June 15, 1989.
Amount:	C$32.8 million.
Expiry Date:	June 15, 1992.
Type:	American put.
Price at Issue:	C$2.65.
Cash Settlement Value in C$:	$100 \text{ NKP.WT.A} = 10.31 \times \left[270.54 - \left(\frac{\text{Nikkei at exercise}}{\text{yen / C\$ at exercise}}\right)\right]$

Other Terms: Materially the same as NKP.WT.

Note: A third Nikkei put warrant was announced by the Bank of Nova Scotia on May 22, 1989. The product was to be a 3-year, at-the-money Nikkei put warrant. On June 13, 1989, the *Financial Post* reported the following brief news item:

> There is some justifiable jubilation at BT Bank of Canada these days. Last Friday, an issue of Nikkei put warrants to be brought to the market by Bank of Nova Scotia was yanked after the underwriters failed to reach the minimum target of $15 million. The Scotiabank product was in competition with an issue being bought to market by BT Bank. The Scotiabank product had the support of the cream of Canada's investment dealers. By contrast, Walwyn Stodgell Cochran Murray, Ltd., was the lead and sole underwriter for the BT product, which was considered more attractive by many. The BT deal closes tomorrow, and the word is that lots of buyers have snapped it up.

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Exhibit 6 Capital Markets Data as of December 18, 1989

Closing value of the Nikkei Index: ¥ 38,586.18
Dividend yield on the stocks included in the Nikkei Index: .49% per year.
Exchange rates: US$1 = ¥144.28 = C$1.16.

Interest rates (Treasury or equivalent government rates):	U.S.($)	Canada (C$)	Japan (¥)
1 year	7.62%	11.72%	6.375%
2 years	7.75	10.48	5.85
3 years	7.69	10.22	5.85

NPWs traded on the Toronto Stock Exchange	NKP.WT	NKP.WT.A
Price (C$)	$2.60	$1.90
Average daily volume (000)	105	171

Sources: Interactive Data Corporation, Toronto Stock Exchange, Goldman Sachs.

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Exhibit 7 Relative Performances of Nikkei 225 Stock Average and Standard & Poor's Index, January 1980-December 18, 1989

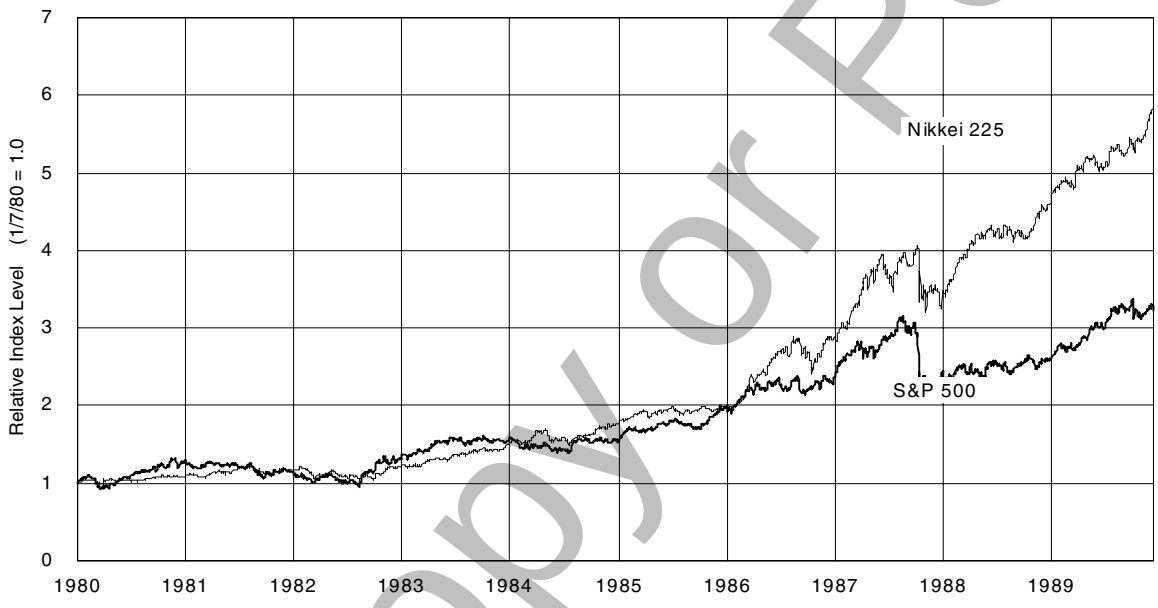

Exhibit 8 ¥/$ Exchange Rate, January 1980-December 18, 1989

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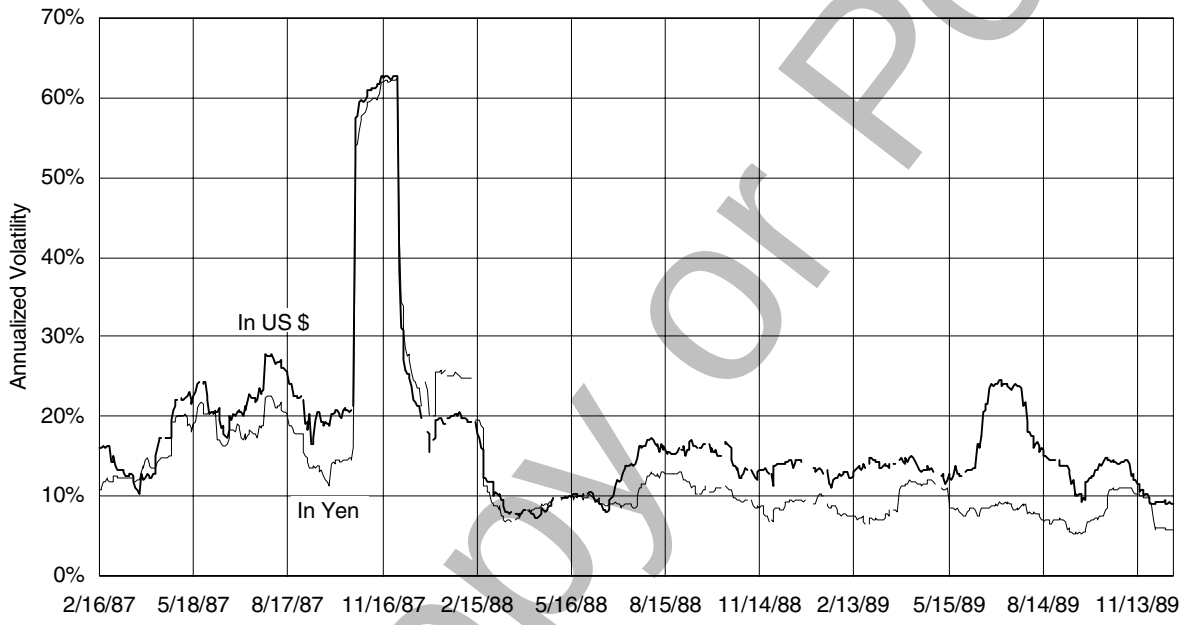
Exhibit 9 Annualized Volatility of the Nikkei 225 Stock Average, Denominated in Yen and U.S. Dollars



Note: Volatility calculated by the casewriter on the basis of past three months' returns, and annualized using a 250-day trading year. Volatility is shown for the Nikkei returns denominated in Yen and for the returns to a Nikkei investment translated into US$ using the spot exchange rate each day. As of mid-December 1989, the most recent volatility was approximately 6% (in yen) or 9% (in dollars). The volatility for the Nikkei denominated in Canadian dollars is very similar to the volatility of the Nikkei in U.S. dollars. A longer history of the volatility of the Nikkei index (denominated in yen) is shown below:

Period	Annualized Volatility
1949-53	20.0%
1954-58	9.7
1959-63	13.4
1964-68	11.1
1969-73	14.4
1974-78	9.8
1979-83	8.5
1984-88	12.7
Average	12.5

Source: William T. Ziemba and Sandra L. Schwartz, *Invest Japan* (Chicago: Probus Publishing, 1992), p. 97.

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