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# Korean Variable Annuities Market





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## EXECUTIVE SUMMARY

Over the past five years, variable annuities (VAs) have become a significant retirement product in Korea. From an insurance company's point of view, VAs are a useful line of business both because they appeal to consumers and because they can help diversify portfolios that have large negative interest spread exposure.

What is next for VAs in Korea? As the country's VA block grows, the minimum guarantee risks of VA products become a more pressing concern. Korean VA writers seek efficient strategies to manage these risks. This report focuses on such strategies and provides insights on the Korean VA market.

## THE KOREAN VA MARKET

The Korean VA market is young and has shown rapid growth in the past five years. In Q2 2009, the net assets under management (AUM) were KRW 21.2 trillion (USD 19.2 billion), which is 2.1% of GDP. That is approximately 1.62% of U.S. VA AUM, and 10.9% of Japanese. The key drivers of this growth are Korea's high savings rate, the public desire for the guarantee protection, and the market's rapid turnover of new business.

Despite a short history, most types of VA guarantees are sold in the Korean market—including the guaranteed minimum accumulated benefit (GMAB), the guaranteed minimum withdrawal benefit (GMWB), and the guaranteed minimum withdrawal benefit for life (GLWB). The guaranteed minimum death benefit (GMDB) is typically provided as a default with any of the living benefits. Highly rich benefit designs are also offered.

But while the Korean VA market is sophisticated in terms of product development, it lags from a risk management perspective. Only a few Korean VA writers are currently implementing efficient, reliable risk management strategies.

The summary of this report is given below:

- Korean VA products have distinct characteristics in their product designs—rich benefits with unreasonably low charges, recurring premium-dominated premium modes, low surrender charges, high front-end loading, an annuity option for GMAB products, and a tiered agent-dominated distribution channel.
- The major types of risks associated with Korean VA products are interest rate risk, equity risk, policyholder behavior risk, basis risk, and model risk. Before the global market downturn, the interest rate exposure was the greatest risk, because VA products are long-term products and more than 95% of the premium type of Korean VA products was recurring. However, that has been reduced by more than 50% since the crisis, which drastically reduced interest rates.
- Few Korean VA writers are actively managing the risks associated with their VA products. Based on our observations of and experience in the Korean VA market, dynamic hedging could be one of the best risk management strategies for the Korean VA writers. However, an efficient implementation would require both dedicated, experienced human resources and a sophisticated computing system.

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**While the Korean VA market is sophisticated in terms of product development, it lags from a risk management perspective. Only a few Korean VA writers are currently implementing efficient, reliable risk management strategies.**

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- The Korean capital market is sufficiently liquid for implementing dynamic hedging programs. In 2008, the total trading volume of KOSPI 200 futures was 64.8 million contracts, which is the seventh largest futures market, and 20.9 million contracts of the 3-year Korean Treasury bond were traded. The notional amount of interest rate swaps is KRW 565 trillion (USD 470.8 billion) and the notional amount outstanding is KRW 3 trillion (USD 2.5 billion). Our case study for a typical 100% Return of Premium (ROP) GMAB product shows that a dynamic hedge program can perform efficiently.
  - To effectively implement a hedge program in Korea, there are several challenges to overcome: regulatory restrictions on interest rate swaps (IRS) trading by insurance companies, modeling of fund mapping, policyholder behavior, needs of expertise, and preparation of the operational system.
  - A principles-based reserving standard is likely to be adopted soon by the Korean regulator Financial Supervisory Service (FSS). The earliest anticipated date is the first half of 2010. The impact of the stochastic reserve will be material for the products developed under no consideration of hedging. In our case study, before-tax CTE60 relative to account value (AV) is about 6.4%, while the accumulated fees are about 0.5% of AV. The before-tax CTE60 is 12.3 times larger than the accumulated fees.
  - The recent global financial market turbulence hit the Korean market as well. The historically low interest rate and high volatility are the dominating challenges for Korean VA writers in pricing and managing guarantee risks. To confront the new market environment and enhance the Korean VA business in the future, a variety of product development strategies can be considered—for instance, adding internal hedging in funds with a volatility management and a capital protection strategy.

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## OVERVIEW OF THE KOREAN VA MARKET

Since GMAB was first introduced by the top three domestic insurance companies (Samsung Life, Korea Life, and Kyobo Life) in October 2002, the Korean VA business has grown rapidly. Most mid-sized domestic and foreign insurance companies entered the market in the following two years, and more than 90% of both domestic and foreign life insurance companies are currently selling VA guarantee products. The first generation of VA products was 100% return of premium (ROP)-based GMAB and GMDB. Unlike in the United States or other countries in Europe or Asia, GMDB is not sold independently in Korea. Instead, ROP-based GMDB is usually embedded in variable annuity products. In addition, there is also a fixed amount of death benefit, typically a pro rata for a single premium type and dollar-for-dollar for a recurring premium type, which is not managed in the separate account but is necessary to qualify for life insurance.

In August 2006, Metlife Korea first launched GMWB with GMDB and Heungkuk Life introduced GMWB for life (GLWB) in June 2008. However, the sizes of the businesses are not as large as their GMAB blocks. Thus far, GMAB with GMDB products still dominate the Korean VA market, and their product designs are more sophisticated than other types of VA products. Richer living benefit structures (e.g., 130% ROP, annual ratchet, 3% or 5% rollup, or a combination of ratchet and rollup) or an aggressive equity allocation are common in these designs.

The table in Figure 1 summarizes the top five best-selling VA products in 2009:

FIGURE 1: BEST-SELLING VA PRODUCTS, 2009

COMPANY	PRODUCT NAME	TYPE	LIVING BENEFIT FEATURES
Samsung Life	Non-par Index-up VA	GMAB/DB	<ul style="list-style-type: none"> <li>• 3/5 yrs Ratchet with 200% Cap</li> <li>• Premium type: Single or Recurring (5~20yrs), Deferral period: 7/9/10+ yrs</li> <li>• Aggressive (Conservative) Fund Allocation : 50/50 (30/70) in Equity/Bond</li> <li>• Equity type: Domestic or Foreign, Bond Type: Domestic</li> </ul>
Korea Life	Non-par V-dex	GMAB/DB Combination of VA and ELI	<ul style="list-style-type: none"> <li>• Before annuitization begins: If AV <math>\geq</math> 130% ROP, then the excess amt above 100% ROP is transferred to ELI account</li> <li>• If AV &lt; 130%, then 100% ROP</li> <li>• Premium type: Single or Recurring (3/5/7/10/15yrs), Deferral period: min 5 yrs</li> <li>• Aggressive (Conservative) Fund Allocation : 50/50 (30/70) in Equity/Bond. Domestic or International equity</li> <li>• Equity type: Domestic or Foreign, Bond Type: Domestic</li> </ul>
Kyobo Life	Non-par Kyobo 3Up Index VA	GMAB/DB	<ul style="list-style-type: none"> <li>• Continuous Ratchet with 130%/150%/200% Cap after the deposit period</li> <li>• Premium type: Single or Recurring (3~20yrs), Deferral period: min 5 yrs</li> <li>• Aggressive (Conservative) Fund Allocation : 50/50 (0/100) in Equity/Bond</li> <li>• Equity type: Domestic or Foreign, Bond Type: Domestic</li> </ul>

**FIGURE 1: BEST-SELLING VA PRODUCTS, 2009 (CONT).**

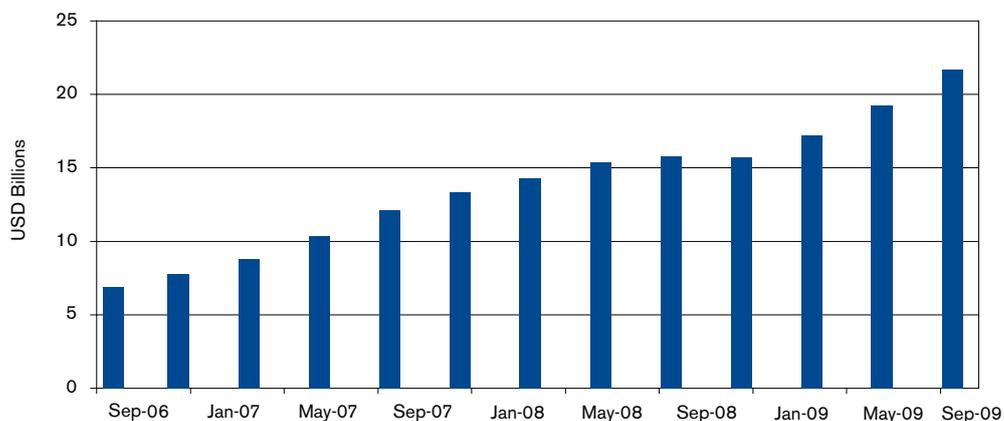
COMPANY	PRODUCT NAME	TYPE	LIVING BENEFIT FEATURES
Kyobo Life	Non-par Kyobo Prime Plus VA	GMAB/DB	<ul style="list-style-type: none"> <li>• 100%/130% ROP</li> <li>• Premium type: Single or Recurring (3~20yrs), Deferral period: min 10 yrs</li> <li>• Aggressive (Conservative) Fund Allocation : 50/50 (0/100) in Equity/Bond</li> <li>• Equity type: Domestic or Foreign, Bond Type: Domestic or Foreign</li> </ul>
Mirae Asset Life	Non-par Mirae Asset [Love Age Premier] VA	GMAB/DB	<ul style="list-style-type: none"> <li>• 100% ROP</li> <li>• Premium type: Recurring (12+yrs), Deferral period: 0 yrs</li> <li>• Aggressive (Conservative) Fund Allocation : 60/40 (0/100) in Equity/Bond</li> <li>• Equity type: Domestic or Foreign, Bond Type: Domestic or Foreign</li> </ul>

Figures 2, 3, and 4 show the historical net asset amount of variable annuities in Korea, the United States, and Japan. The Korean VA business has grown steadily and rapidly over the past four years. The rate of growth in Korea for 2006-2009 is quite similar to that of Japan for 2004-2007. This reveals that both Korea and Japan experienced a period of rapid growth shortly after VA products were introduced, while the U.S. market was mature by 2000.

The net assets of variable annuities as of Q2 2009 for those three countries are summarized in the table in Figure 5 (on page 7). The GDPs of the respective countries are also shown as a reference of VA penetration. The AUM of Korean VA business is 1.62% that of U.S. VA, and 10.9% that of Japanese VA, but the AUM of Korean VA business is about 2.1% of the Korean annual GDP, which implies substantial growth potential when compared with the U.S. VA penetration of 8.4% GDP.

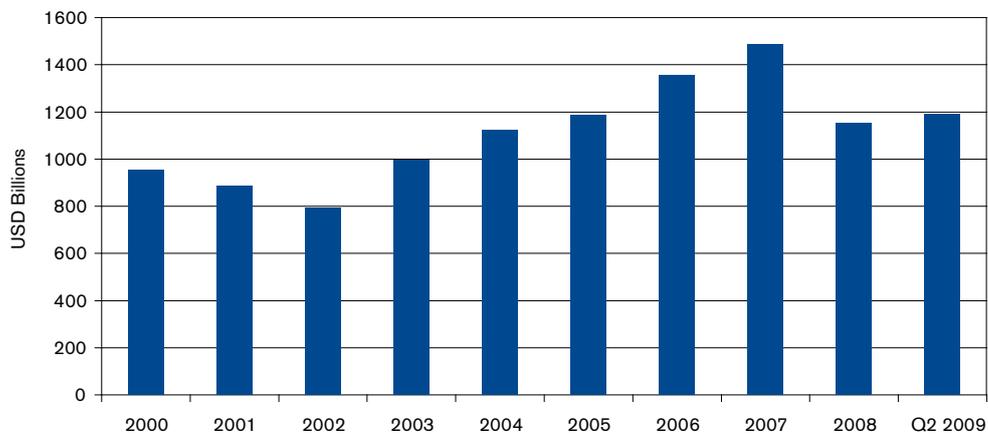
**Both Korea and Japan experienced a period of rapid growth shortly after VA products were introduced, while the U.S. market was mature by 2000.**

**FIGURE 2: KOREAN VA NET ASSETS UNDER MANAGEMENT**



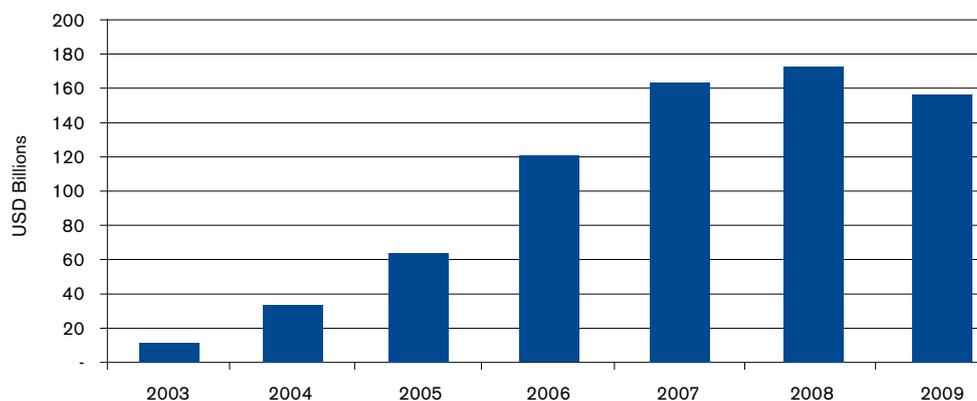
(Source: KLIA)

**FIGURE 3: U.S. VA MARKET ASSETS UNDER MANAGEMENT**



(Source: NAVA and LIMRA International)

**FIGURE 4: JAPANESE VA MARKET ASSETS UNDER MANAGEMENT**



(Source: Hoken Mainichi Shinbun)

One of the reasons for this rapid growth is the outperformance of the stock market over the previous decade during that period. Because VA guarantees are recognized more as an investment vehicle than a retirement benefit product, Korean consumers tend to purchase VA guarantees when the market is bullish and to leave the contract when the market is bearish, even though this behavior is not optimal in terms of guarantee benefit usage. Figure 6 shows the first-month premium, including single premiums, and the KOSPI 200 index movement from Q2 2003 to Q2 2009. The VA sales trend reacts highly sensitively to the stock market movement. In 2005, the VA sales were accelerated by the introduction of mutual funds in Korea.

Because VA guarantees are recognized more as an investment vehicle than a retirement benefit product, Korean consumers tend to purchase VA guarantees when the market is bullish and to leave the contract when the market is bearish

**FIGURE 5: VA ASSETS UNDER MANAGEMENT WITH GDP (UNIT: USD IN BILLIONS)**

COUNTRY	KOREA	UNITED STATES	JAPAN
<b>VA AUM</b>	<b>19.2</b>	<b>1,190</b>	<b>158</b>
<b>GDP</b>	<b>929</b>	<b>14,204</b>	<b>4,909</b>
<b>VA AUM/GDP</b>	<b>2.1%</b>	<b>8.4%</b>	<b>3.2%</b>

(Source: World Bank)

**FIGURE 6: KOREAN VA SALES VOLUME AND KOSPI 200 INDEX MOVEMENT**



(Source: KLIA)

Other key drivers of this market growth are summarized below:

#### Large portion of new business

Historically, one insurance company launches at least three VA products in a year. Because Korean consumers have the tendency to leave the contracts as long as the principal can be paid back, approximately 30% of the policyholders lapse during the first two to three years. In order to take this into account in VA sales, more frequent releases of new business are inevitable for VA writers in Korea. In particular, the growth before 2008 was accelerated by new businesses, but not many new products have been sold in the market since the global financial crisis in 2008.

#### Guarantee protection

VA guarantees are attractive because they provide the upside potential, but still guarantee the floor of the profit. As stated earlier, the sizes of GMWB or GMWB for life are much smaller than that of GMAB. The major GMAB maturities are seven years or 10 years. Moreover, guaranteed minimum income benefit (GMIB) has not been introduced yet in Korea. This indeed characterizes the Koreans' investment preference. They prefer aggressive and short-term investment to conservative and long-term investment. The guarantee protection fits the Korean consumer's needs by alleviating the downside fear.

#### Relatively high savings rate

The largest financial asset is bank deposit in Korea. In Q4 2008, the Korean household net savings rate, savings as a percentage of disposable income, was 2.8%, of which more than 50% was bank deposit. Given that the interest rate for a one-year installment savings account was 5.5% in Q4 2008 and 3.8% in Q2 2009, 3% to 7% rollup GMAB products are attractive to Korean customers. This implies a significant growth potential in the Korean VA market.

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## IMPACT OF THE FINANCIAL CRISIS ON THE KOREAN MARKET

The Korean economy experienced another severe market downturn during the financial crisis in 2008, with the memory of the Asian financial crisis in 1997 still fresh. The most notable changes in the market are as follows:

- **Historically low interest rate:** During the crisis, 3-year KTB yield dropped to 4.5% from 6%. After the crisis, 3-year KTB yield has gradually decreased to 3.5%. It went back to 4% as of Q2 2009, but has still not recovered to the average historical level.
- **High volatility:** The 10-year implied volatility of the KOSPI 200 jumped up to 46.11% from 25.25% during the crisis, and went down to 28.75% in Q2 2009. Although the volatility has been somewhat stabilized, the highly volatile environment is likely to continue for some period of time.
- **Strong correlation in funds:** As the global market plunged, almost simultaneously the correlation between one economy and another became stronger. This resulted in poor performance of the funds underlying VA products.

The common reactions of Korean VA writers to such drastic market changes are to cease some of the existing VA businesses, to scale back on the existing product designs, or to increase fees. They have also postponed the release of new businesses.

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**Before 2008, risk management was not a major factor to be considered in the product development process in Korea. Instead, sales and marketing were the major concerns of Korean VA writers.**

## OVERVIEW OF KOREAN VA PRODUCTS

Before 2008, risk management was not a major factor to be considered in the product development process in Korea. Instead, sales and marketing were the major concerns of Korean VA writers. As a result, richer benefit structures and aggressive funds with unreasonably low charges became popular. There are several unique features of Korean VA products, as detailed below:

### **GMDB provided as default with guaranteed minimum living benefit (GMLB)**

GMDB in Korean VA products is somewhat different from GMDB in the United States, Europe, or Japan. It is not sold independently, but provided as a default benefit with other GMLB products. It guarantees the greater of either 100% of ROP or a fixed amount (e.g., 5% of a single premium or KRW 5 million for a monthly premium type) on top of AV at the time of death. The fixed amount is predetermined and no greater than the accumulated amount of the cost of insurance (COI) charge at a crediting rate. This feature qualifies the variable annuity as a traditional life insurance product under Korean insurance regulation.

### **Low rider charges, but rich benefit structures and aggressive funds**

Various types of guarantees have been introduced in Korea. Most of the guarantee types are sold in the Korean VA market, except for GMIB. A variety of benefit structures was also introduced, such as a 3% or 5% rollup, an annual ratchet, or a combination of rollup and ratchet. The typical fund allocation is 50/50 between Korean equity and Korean bond markets, but it was quite aggressive in the first generation of VA products, which allowed the equity-to-bond ratio to be as high as 70/30. International equity funds were other popular types of funds. The benefit structures became richer, but the rider charges have not increased much. The rider charges of the first generation of VA products were mostly 50 or 55 bps, but those of the recent products are 75 to 85 bps. After the financial crisis in 2008, some VA writers raised the fees up to 90 to 100 bps, but the increase by 25 bps is not enough by far to cover future claims under the current market conditions.

### **Low surrender charge**

The typical surrender charge is the remainder of the accumulated loadings at a predetermined rate at the time of surrender, but the amount of the loadings after issue is usually too small to affect the policyholder's decision of surrender. Low surrender charges do not encourage policyholders to maintain their contracts until maturity.

### **Major mode of premium is recurring, especially monthly**

More than 90% of the account value of VA is on the monthly recurring premium mode. Thus, the cash inflow of most Korean VA writers is heavily back-loaded. This is primarily driven by the Korean VA policyholder population, which is dominated by *salary-man* workers paying through monthly installments.

### **High front-end (alpha) loadings**

A VA guarantee is a put option because the payoff is determined by AV and the guaranteed benefit. At maturity, if AV is greater than the minimum guarantee level at maturity, the payoff is zero. Otherwise, the payoff is the excess of the minimum guarantee level over AV. Because of substantially high front-end loadings, most of the VA guarantees are in-the-money at inception. For those in-the-money options, if the market performs poorly for the first few years, it is less likely that AV is recovered up to the level of the minimum guarantee. Thus, it is a major challenge for VA writers to provide low charges with competitive product designs.

### Annuity payout option for GMAB

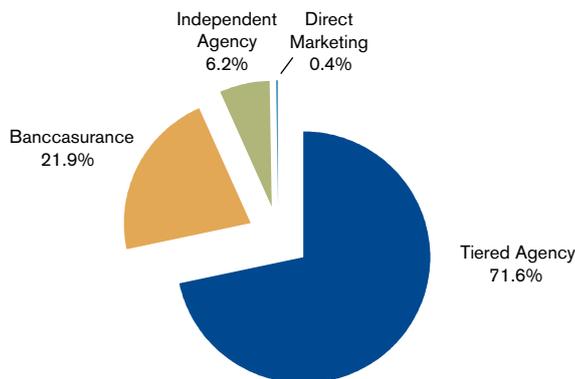
Korean GMAB products are a combination of GMAB and GMIB in the sense that policyholders have an option to take their benefit amount as a lump sum payment or annuitize the benefit at maturity. However, no Korean VA writer prices GMAB products with the consideration of the annuity payout option. If a large number of policyholders unexpectedly choose this option, the future claim will severely deviate from the current expected claim amount.

### Distributional channel

A tiered agency channel dominates the sales distribution. As a group of sales agents who work for an insurance company, the tiered agency is different from an independent agency. Although the tiered agency channel still has a large proportion of the so-called *housewife* agents, many tiered agencies have been trying to professionalize their sales force in recent years. Banks started selling insurance products in 2003, but their sales volumes are not as large as that of the agency channel. Figure 7 shows the sales distribution of VA products as of Q1 2009. Major customers of the tiered agents are their friends or families. Their large portion of the purchase of insurance products is due to their personal relationships with the agents, and it often results in high lapses before maturity.

**Korean GMAB products are a combination of GMAB and GMIB in the sense that policyholders have an option to take their benefit amount as a lump sum payment or annuitize the benefit at maturity.**

FIGURE 7: SALES DISTRIBUTION OF VA PRODUCTS



(Source: KLIA)

## POSSIBLE RISK MANAGEMENT STRATEGIES IN KOREA

Since 2008, Korean VA writers have had a great interest in managing guarantee risks, but the number of companies undertaking active risk management strategies is small. One of the foreign insurance companies based in Korea dynamically hedges its VA block via its headquarters office outside of Korea, and some insurance companies statically hedge selected blocks of their VA products by purchasing customized put options from investment banks.

What is preventing the majority of Korean companies from implementing hedge strategies is the lack of expertise and the mentality that no one wants to be the first to implement something new. The current regulatory environment does not push Korean VA writers to hedge their risks either.

However, there is a strong undercurrent in the Korean insurance industry for implementing hedging programs so that the economic fundamentals of the industry can be protected. Given the unique benefit structures of Korean VA products, the following risk management strategies can be adopted:

### Static hedging

This is one of the simplest strategies to manage guarantee risks by purchasing third-party options. The challenge of this approach is that the prices of those options are often expensive and unstable. For instance, the prices of put options are in the range of 120-200 basis points, while insurance companies receive 45 to 75 basis points of rider charges. Also, the size of the underlying asset for the options is limited by the option provider. This strategy can be adopted for a small block of business as long as the offered prices of options fall in a reasonable range, but a single use of this approach for the entire VA business of the company is much harder to achieve.

### Dynamic hedging

Dynamic hedging is to offset the risk exposure of VA guarantees by trading derivatives periodically. Because only simple derivatives—usually highly liquid, such as equity futures or interest rate futures—are utilized in the hedging process, the implementation of a dynamic hedging program is less sensitive to changes in regulation and the contraction of derivative markets. Moreover, this strategy can be easily modified by a company to reflect changes in products and strategies. For instance, rho hedging can be quickly unwound under a low interest rate environment, and equity futures trading can be increased to capture gamma risk. Although this approach is complex and therefore requires high levels of expertise and robust operational processes, the majority of VA writers are currently taking this approach in the United States, where its effectiveness has been proved. During the market turbulence in 2008 and 2009, the VA hedging programs were 93% effective on average (Sun and Mungan, 2009). Also, Japanese domestic VA writers started running hedge programs for internal valuation purpose. Given the current Korean market condition, dynamic hedging can be the basis for risk management strategy for Korean VA writers.

### Reinsurance

Reinsurance is one of the feasible and convenient risk management strategies for VA products to reduce reserve and capital requirement as well as to mitigate minimum guarantee risk. However, the availability of reinsurance capacity has been a chronic issue. Currently, there are no VA reinsurers operating in Korea. The financial reinsurance transaction is prohibited under Korean regulation. Several multinational reinsurers attempted to enter the market, but a lack of experience in the Korean market did not make it easy for them to offer competitive quotes. Historically, the Korean insurance market has seen a parade of reinsurers revolving through the market, sometimes in quick successions.

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## GUARANTEE RISKS ASSOCIATED WITH KOREAN VA PRODUCTS

Risks associated with VA guarantees generally fall into three categories: market risk, actuarial risk, and operational risk. Equity risk, interest rate risk, correlation risk, and basis risk belong to the market risk class; mortality/morbidity risk and policyholder behavior risk are in the actuarial risk class; and model risk and management risk are in the operational risk class. Depending on the specifications of VA products, different risks can play a dominant role in different products.

In theory, dynamic hedging is a powerful tool to manage market risks, but it does not protect against actuarial risks or operational risks. Actuarial and operational risks can be minimized by the selection of the appropriate hedging strategy, the consistent performance of hedgers, and a powerful computing system. Operational risks can never be totally eliminated, but can be substantially addressed through effective risk management. Actuarial risks can be managed through conservative assumptions and a large enough volume of business.

Based on the characteristics of Korean VA products, we analyzed the significance of risks embedded in Korean VA products in the context of dynamic hedging.

- **Equity exposure:** The future claims of VA products are defined by AV at maturity, and the AV is determined by the fund performance. Given this, all VA products are exposed to the equity movement in funds. The portion of equity in funds is one of the key factors to determine the size of equity exposure. For example, let us consider a typical 10-year, 100% ROP GMAB product assuming that KRW 500,000 of monthly premium is collected for five years. We analyzed two equity/bond allocations of 30/70 and 50/50, which are two common fund ratios in Korean VA products. The table in Figure 8 shows that a 1% delta of the 50/50 mixed fund is twice as large as that of the 30/70 mixed fund. A delta of the 30/70 mixed fund and the 50/50 mixed fund are only 4 bps and 7 bps, respectively. It can also be noted that a 20% increase in equity allocation more than doubles the hedge cost from 70 bps to 146 bps.

**In theory, dynamic hedging is a powerful tool to manage market risks, but it does not protect against actuarial risks or operational risks.**

**FIGURE 8: ATTRIBUTION ANALYSIS OF 100% ROP GMAB PRODUCT**

ALLOCATION (EQUITY/BOND)	HEDGE COST	DELTA	RHO	EQUITY EXPOSURE	INTEREST RATE EXPOSURE
30/70	0.70%	-10,864	-1,567,867	-35,775	-1,111,963
50/50	1.46%	-21,914	-1,999,543	-72,160	-1,418,117

- **Interest rate exposure:** The interest rate exposure of VA products is generally significant because of the long maturity period of its guarantees. In particular, it is much more material for recurring premium products, which are the majority of Korean VA products. In the previous example, values of 10 bps rho for the 30/70 and 50/50 mixed funds are KRW 1.6 million and KRW 2 million, respectively. Equity exposure and interest rate exposure are given in the last two columns of the table in Figure 8, assuming that a weekly log return of KOSPI 200 is 3.29% and a weekly movement of interest rate is 0.07%. For the 50/50 mixed fund, the rho exposure is approximately 20 times larger than the delta exposure. The ratio of rho exposure to delta exposure for the 30/70 mixed fund is even greater than that of the 50/50 mixed fund, which is 31 times. This is due to the larger bond portion in the 30/70 mixed fund. For our sample cell, the size of rho exposure is fairly larger than that of delta exposure. This is because it is a new business. The difference between rho and delta exposure gets smaller as the product matures because rho decreases and delta increases as it is close to maturity.

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**Korean VA products are exposed to much greater policyholder behavior risk than VA writers in any other countries are.**

- **Basis risk:** A large number of Korean VA products provide various types of funds to customers. The simplest funds consist of a domestic equity and a domestic bond, but the most complex funds are composed of international equity funds such as BRIC funds,<sup>1</sup> China funds,<sup>2</sup> South America funds, etc. Those international funds are likely un-hedgeable because of the lack of reasonable benchmark funds. These funds are exposed to substantial basis mismatch even if benchmarks exist because these funds are often actively managed. A large basis mismatch results in a poor performance of a hedge program. Hence, dynamic hedging is not a realistic choice of risk management for products with aggressive international funds.
- **Policyholder behavior risk:** Policyholder behavior is difficult to predict in general. However, Korean VA products are exposed to much greater policyholder behavior risk than VA writers in any other countries are. In particular, the major portion of customers of the tiered agents, the largest sale channel, consists of their friends or families. Many of those customers do not purchase the products based on their needs. Instead, they generally buy contracts because of their relationship with the tiered agents, and when their policies are terminated, it is not because of economic considerations such as the value of guarantees and surrender charges.
- **Model risk:** Dynamic hedging is a complex risk management strategy. To enhance the effectiveness of hedging, sophisticated modeling is essential. The first challenge in modeling is to set appropriate assumptions for the valuation of guarantee options. VA hedging schemes are based on the risk-neutral assumption, which is the most important. However, few Korean VA writers have confidence in determining the assumptions for risk-neutral valuation. For instance, only a few VA writers currently have market-consistent, risk-neutral pricing models in Korea. Moreover, a lack of expertise in this area adds more uncertainty to the difficulty of modeling a hedge program.

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1 BRIC stands for the emerging markets of Brazil, Russia, India, and China. BRIC fund is a mutual fund that invests in stocks and listed securities of BRIC nations.  
2 China fund is a mutual fund that invests in stocks and listed securities of China.

## OVERVIEW OF THE KOREAN CAPITAL MARKET FOR HEDGING

The major types of funds in VA guarantees are combinations of domestic equity (KOSPI 200) and domestic bond (3-year Korean Treasury bond [KTB]). Given this, Greeks to be hedged are delta and rho. Possible hedging instruments to hedge risks associated with those products will be KOSPI 200 futures for delta, and Korean government bond futures or interest rate swaps (IRS) for rho.

### Exchanged-traded derivatives: Equity and bond futures

The Korean derivative market is one of the largest derivative markets in the world. It has been ranked second based on the number of traded contracts, following the United States, in the comparison between countries. The table in Figure 9 shows the rate of growth in trading volume and the relative trading volumes of the top 15 countries from 2005 to 2008. The rate of growth is a growth rate relative to the previous year and the relative trading volume is the ratio of the trading volume of the country to the total trading volume of the 15 countries. Historically, the Korean derivative market is index-option-dominated, but the trading volume of index futures gradually increases as the bank's use of index futures increases.

Historically, the Korean derivative market is index-option-dominated, but the trading volume of index futures gradually increases as the bank's use of index futures increases.

FIGURE 9: HISTORICAL RELATIVE TRADING VOLUME OF TOP 15 COUNTRIES

COUNTRY	2005	2006	2007	2008	RANK
USA	26.1 [35.3]	29.7 [38.6]	33.0 [39.3]	14.1 [39.4]	1
KOREA	0.2 [26.0]	-4.6 [20.9]	12.2 [17.9]	3.3 [16.2]	2
GERMANY	17.2 [12.5]	22.3 [12.9]	24.4 [12.3]	14.0 [12.3]	3
UK	8.2 [5.4]	29.9 [5.9]	33.4 [6.1]	16.0 [6.1]	4
CHINA	8.4 [1.9]	43.0 [2.2]	69.0 [2.9]	72.7 [4.4]	5
BRAZIL	11.8 [4.7]	22.0 [4.8]	39.0 [5.1]	-6.6 [4.2]	6
INDIA	171.2 [2.0]	44.0 [2.5]	64.9 [3.1]	46.6 [4.0]	7
REPUBLIC OF SOUTH AFRICA	33.8 [0.5]	104.7 [0.9]	213.8 [2.1]	55.8 [2.9]	8
RUSSIA	0.0 [0.0]	0.0 [0.0]	0.0 [1.5]	61.9 [2.1]	9
JAPAN	-5.6 [1.9]	13.0 [1.8]	18.4 [1.7]	22.5 [1.8]	10
SWEDEN	10.1 [1.0]	17.7 [1.0]	15.7 [0.9]	0.6 [0.8]	11
NETHERLANDS	18.8 [0.9]	28.2 [1.0]	26.0 [0.7]	-11.1 [0.8]	12
TAIWAN	56.7 [0.9]	23.7 [1.0]	0.5 [0.7]	18.7 [0.8]	13
FRANCE	-23.7 [2.4]	-64.6 [0.7]	5.6 [0.6]	6.1 [0.5]	14
AUSTRALIA	16.7 [0.9]	15.7 [0.8]	15.4 [0.8]	-18.4 [0.5]	15
TOTAL	12.5 [100.0]	18.9 [100.0]	30.5 [100.0]	14.0 [100.0]	

(SOURCE: KRX)

KOSPI 200 futures are highly liquid and thus excellent candidates for delta hedging in the Korean market. In 2008, the KOSPI 200 futures were ranked seventh among worldwide index futures based on the trading volume. The trading volume of the KOSPI 200 futures is 10.23% of that of the E-mini S&P 500 futures,<sup>3</sup> which is the world's largest. The historical trading volumes of top 10 index futures are given in the table in Figure 10.

**FIGURE 10: HISTORICAL TRADING VOLUMES OF TOP 10 INDEX FUTURES (UNIT: MILLION CONTRACTS)**

CONTRACT	EXCHANGE	2003	2004	2005	2006	2007	2008	RANK
<b>E-MINI S&amp;P 500 FUTURES</b>	<b>CME</b>	<b>161.2</b>	<b>161.7</b>	<b>207.1</b>	<b>257.9</b>	<b>415.3</b>	<b>633.9</b>	<b>1</b>
<b>DJ EURO STOXX 50 FUTURES</b>	<b>EUREX</b>	<b>116.0</b>	<b>121.7</b>	<b>140.0</b>	<b>213.5</b>	<b>327.0</b>	<b>432.3</b>	<b>2</b>
<b>S&amp;P CNX NIFTY FUTURES</b>	<b>NSE INDIA</b>	<b>10.6</b>	<b>23.4</b>	<b>47.4</b>	<b>70.3</b>	<b>138.8</b>	<b>202.4</b>	<b>3</b>
<b>E-MINI NASDAQ 100 FUTURES</b>	<b>CME</b>	<b>67.9</b>	<b>77.2</b>	<b>72.5</b>	<b>79.9</b>	<b>95.3</b>	<b>108.7</b>	<b>4</b>
<b>NIKKEI 225 MINI FUTURES</b>	<b>OSE</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>6.2</b>	<b>49.1</b>	<b>95.4</b>	<b>5</b>
<b>RTS INDEX FUTURES</b>	<b>RTS</b>	<b>3.9</b>	<b>17.1</b>	<b>28.9</b>	<b>41.7</b>	<b>34.2</b>	<b>87.5</b>	<b>6</b>
<b>KOSPI 200 FUTURES</b>	<b>KRX</b>	<b>62.2</b>	<b>55.6</b>	<b>43.8</b>	<b>46.6</b>	<b>47.8</b>	<b>64.8</b>	<b>7</b>
<b>MINI-SIZED \$5 DJIA FUTURES</b>	<b>CME</b>	<b>10.9</b>	<b>20.7</b>	<b>24.9</b>	<b>26.8</b>	<b>40.1</b>	<b>55.3</b>	<b>8</b>
<b>CAC 40 FUTURES</b>	<b>LIFFE</b>	<b>29.3</b>	<b>24.1</b>	<b>25.0</b>	<b>33.4</b>	<b>44.7</b>	<b>49.2</b>	<b>9</b>
<b>DAX FUTURES</b>	<b>EUREX</b>	<b>27.2</b>	<b>29.2</b>	<b>32.7</b>	<b>40.4</b>	<b>50.4</b>	<b>47.0</b>	<b>10</b>

(Source: Futures Industry Association)

**This data implies that Korea has a very active futures market, and that any futures-based hedging programs for VA products will not run into market capacity issues.**

In Q2 2009, the total trading volume of the KOSPI 200 futures was 6.3 million contracts and the total trading value was KRW 6 quadrillion (USD 5 trillion). This is about five times Korean GDP. This data implies that Korea has a very active futures market, and that any futures-based hedging programs for VA products will not run into market capacity issues. The table in Figure 11 summarizes historical daily trading volumes and trading values with the outstanding contracts of KOSPI 200 futures.

**FIGURE 11: HISTORICAL DAILY AVERAGE TRADING TREND OF KOSPI 200 FUTURES (UNIT: CONTRACTS, KRW BILLION)**

	2006	2007	2008	Q2 2009
<b>DAILY AVERAGE TRADING VOLUME</b>	<b>188,688</b>	<b>186,278</b>	<b>388,572</b>	<b>334,958</b>
<b>DAILY AVERAGE TRADING VALUE</b>	<b>16,485</b>	<b>22,642</b>	<b>30,340</b>	<b>29,874</b>
<b>OUTSTANDING CONTRACTS</b>	<b>90,953</b>	<b>91,487</b>	<b>118,066</b>	<b>122,266</b>

(Source: KRX, 2009)

The historical monthly trading trend of KOSPI 200 futures from September 2008 to August 2009 is given in the table in Figure 12. The trading activity of KOSPI 200 futures shrank because of the 2008 financial crisis, but it has revived in recent months. The daily outstanding balance is only about 2% of the total traded contracts as of September 2009. This can imply that the use of KOSPI 200 futures for hedging purposes is yet small in the Korean market.

<sup>3</sup> This is SP 500 index futures traded on CME's Globex electronic trading platform.

**FIGURE 12: HISTORICAL MONTHLY TRADING TREND OF KOSPI 200 FUTURES**  
(UNIT: MILLION CONTRACTS, KRW MILLION)

DATE	TOTAL TRADING CONTRACTS	DAILY AVERAGE OF # OF TRADING CONTRACTS	CHANGE (%) TO PREVIOUS MONTH	DAILY AVERAGE OF CONTRACT		# OF TRADING DAYS
				AMOUNT OF TRADING CONTRACTS (MILLION KRW)	DAILY AVERAGE OF # OF OUTSTANDING CONTRACTS	
2008/09	6.50	0.309	28.7	29.05	0.122	21
2008/10	8.54	0.388	25.5	30.31	0.118	22
2008/11	8.47	0.423	9.1	29.78	0.121	20
2008/12	7.27	0.346	-18.2	25.20	0.117	21
2009/01	5.89	0.310	-10.5	23.49	0.099	19
2009/02	7.32	0.366	18.1	27.16	0.112	20
2009/03	7.72	0.351	-4.1	25.94	0.110	22
2009/04	8.42	0.383	9.0	32.68	0.103	22
2009/05	6.58	0.346	-9.5	30.98	0.112	19
2009/06	7.37	0.335	-3.3	29.87	0.122	22
2009/07	6.54	0.284	-15.1	26.76	0.121	23
2009/08	6.32	0.301	5.8	30.87	0.130	21
2009/09	6.63	0.301	0.1	32.65	0.121	22

(Source: KRX, 2009)

For KTB futures, the underlying assets are treasury bonds with 8% of coupon rate, and the coupon payments are semiannual. The trading volume of KTB futures was ranked 11th worldwide for 2006 and 2007, but it has been reduced since then. The table in Figure 13 shows the historical trading volume of the top nine Treasury bond futures with Korean Treasury bond futures. The trading volume of Korean Treasury bond futures is quite close to the size of the 3-year Australian Treasury bond futures.

**FIGURE 13: HISTORICAL TRADING VOLUME OF TOP NINE TREASURY BOND FUTURES WITH KOREAN TREASURY BOND FUTURES (UNIT: MILLION CONTRACTS)**

CONTRACT	EXCHANGE	2003	2004	2005	2006	2007	2008	RANK
<b>EURO-BUND FUTURES</b>	<b>EUREX</b>	244.4	239.8	299.3	319.9	338.3	257.8	1
<b>10 YEAR TREASURY NOTE FUTURES</b>	<b>CME</b>	146.7	196.1	215.1	255.6	349.2	256.8	2
<b>EURO-SCHATZ FUTURES</b>	<b>EUREX</b>	117.4	122.9	141.2	165.3	181.1	174.2	3
<b>5 YEAR TREASURY NOTE FUTURES</b>	<b>CME</b>	73.7	105.5	121.9	124.9	166.2	168.1	4
<b>EURO-BOBL FUTURES</b>	<b>EUREX</b>	150.1	159.2	158.3	167.3	170.9	155.1	5
<b>30 YEAR TREASURY BOND FUTURES</b>	<b>CME</b>	63.5	72.9	86.9	93.8	107.6	89.5	6
<b>2 YEAR TREASURY NOTE FUTURES</b>	<b>CME</b>	4.4	9.5	21.2	38	68.6	79.3	7
<b>10 YEAR TREASURY NOTE OPTIONS ON FUTURES</b>	<b>CME</b>	6.7	8.6	11	15.1	61.5	56.8	8
<b>3 YEAR TREASURY BOND FUTURES</b>	<b>ASX</b>	19.2	22.8	25.9	31	33.6	26.1	9
<b>TREASURY BOND FUTURES</b>	<b>KRX</b>	10.3	7.4	11.2	10.3	13.0	21.5	

(Source: Futures Industry Association)

The 3-year KTB futures dominate the government bond futures market; 81,000 contracts of 3-year KTB futures are traded daily on average and the total trading volume was 1.7 million contracts in

Q2 2009, which is nearly 90% of the total trading volume of the KTB futures. The trading volumes of 5-year KTB futures are relatively small at present, but gradually increase over time. Ten-year KRB futures are not currently traded.

The table in Figure 14 shows the historical monthly trading trend of 3-year KTB futures from September 2008 to August 2009. The outstanding balance of 3-year KTB futures is about 9% of the total traded contracts, which is larger than that of KOSPI 200 futures. This provides evidence that demand of 3-year KTB futures for hedging are greater than that of KOSPI 200 futures.

**FIGURE 14: HISTORICAL MONTHLY TRADING TREND OF 3-YEAR KTB FUTURES  
(UNIT: MILLION CONTRACTS, KRW MILLION)**

DATE	TOTAL TRADING CONTRACTS	DAILY AVERAGE OF # OF TRADING CONTRACTS	CHANGE (%) TO PREVIOUS MONTH	DAILY AVERAGE	DAILY	# OF TRADING DAYS
				OF CONTRACT AMOUNT	AVERAGE OF # OF OUTSTANDING CONTRACTS	
				OF TRADING CONTRACTS (MILLION KRW)		
2008/09	1.51	0.072	20.5	7.59	0.164	21
2008/10	1.33	0.061	-15.6	6.52	0.148	22
2008/11	1.04	0.052	-14.6	5.60	0.143	20
2008/12	0.82	0.039	-24.3	4.32	0.131	21
2009/01	1.31	0.069	76.1	7.76	0.146	19
2009/02	1.61	0.080	16.5	8.97	0.162	20
2009/03	1.50	0.068	-15.2	7.60	0.146	22
2009/04	1.51	0.069	0.6	7.62	0.158	22
2009/05	1.47	0.077	12.3	8.55	0.174	19
2009/06	1.81	0.082	6.6	9.05	0.146	22
2009/07	1.71	0.075	-9.3	8.20	0.154	23
2009/08	1.70	0.081	8.8	8.87	0.153	21

(Source: KRX, 2009)

In the Korea Exchange (KRX), the initial margin of KOSPI 200 futures is 15% or more of the order value, which equals [price × number of contracts × KRW 500,000], with 5% in cash. The maintenance margin rate is 10% of the order value.

The initial margin of 3-year KTB futures is 1.5% of the order value (price × number of contracts × KRW 100 million), and the maintenance margin is 1%. The table in Figure 15 summarizes the margin requirements of KOSPI 200 futures and 3-year KTB futures per contract.

**FIGURE 15: MARGIN REQUIREMENTS OF KOSPI 200 FUTURES AND 3-YEAR KTB FUTURES**

PRODUCTS	INITIAL MARGIN RATE	MAINTENANCE MARGIN RATE
KOSPI 200 FUTURES	15.0%	10.0%
3-YEAR KTB FUTURES	1.5%	1.0%

(Source: Korea Financial Investment Association, 2008)

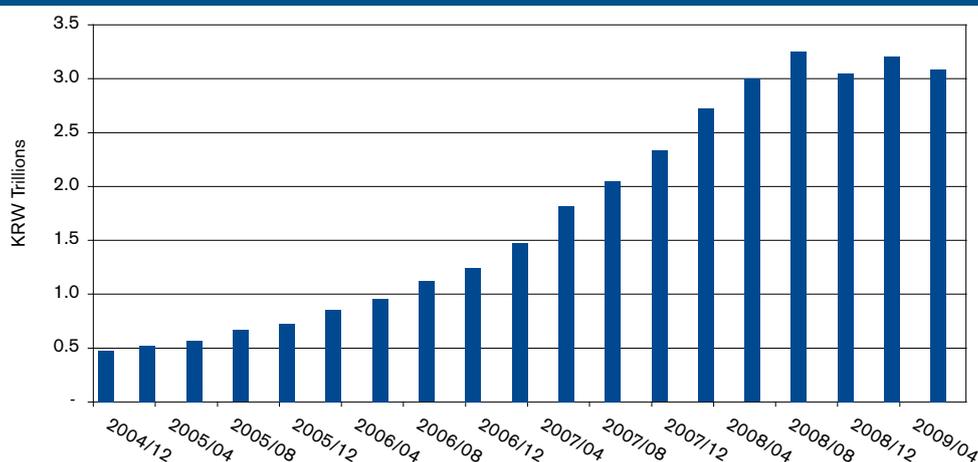
The transaction costs of both KOSPI 200 futures and 3-year KTB futures are very low. It is KRW 10,000 per contract for KOSPI 200 futures and KRW 5,000 per contract for KTB futures.

#### OTC derivatives: Interest rate swap

IRS with various maturities from six month to 10 years are actively traded in the over-the-counter (OTC) market. The total notional amount of IRS is KRW 577 trillion (USD 480.8 billion), and the outstanding balance was KRW 3.1 trillion (USD 2.57 billion) in Q2 2009. A large portion of the trading volumes is from the short-term maturity products like 1-year or 3-year IRS. The liquidity of long-term IRS like 7-year or 10-year IRS is somewhat low. However, the notional amount outstanding for both short-term and long-term IRS grew rapidly for the past five years. Figure 16 shows the quarterly notional amount outstanding of IRS during Q4 2004 to Q3 2008. The vast majority of this growth is contributed by banks to use for hedging purposes.

The liquidity of long-term IRS like 7-year or 10-year IRS is somewhat low. However, the notional amount outstanding for both short-term and long-term IRS grew rapidly for the past five years.

FIGURE 16: KOREAN IRS: QUARTERLY NOTIONAL AMOUNT OUTSTANDING



As the IRS market matures, the bid-ask spread of IRS is narrower and less volatile. Historically, the spread varies in the range of 1-4 bps, and 3 bps on average, but the average spread of IRS in Q3 2008 was 2 bps. The table in Figure 17 shows the historical bid-ask spread of IRS for different maturities. This appears to be a good signal for further growth in the IRS market in the future.

FIGURE 17: HISTORICAL BID-ASK SPREAD OF IRS (UNIT: %)

YEAR \ MATURITY	1 YR	3 YR	5 YR	7 YR	10 YR
2005	0.04	0.03	0.04	0.04	0.04
2006	0.03	0.03	0.03	0.03	0.03
2007	0.01	0.01	0.02	0.02	0.02
2008	0.02	0.02	0.02	0.02	0.02
AVERAGE	0.03	0.03	0.03	0.03	0.03

## CASE STUDY: DYNAMIC HEDGING PERFORMANCE

To examine the hedge effectiveness in the Korean market, we considered a hypothetical block of 100% ROP-based GMAB with GMDB with 10-year maturity. The initial AV is KRW 1 trillion and grows in a 50/50 mix of equity and bond. This type of VA product is typical in Korea.

Capital market assumptions were selected based on historical data. An annual risk-free rate is 3.5%, and the volatilities of equity and bond are 35% and 3%, respectively. No correlation is assumed.

Actuarial assumptions are simplified to the annual rate in total. A total annual decrement is 15% and no dynamic lapse is assumed. Because dynamic hedging is designed to manage market risks, dynamic lapse modeling is irrelevant to the hedge effectiveness. Typical AV-based fees and loadings are assumed.

Delta and Rho hedging strategies with weekly rebalancing were considered. The hedge instruments are KOSPI 200 futures and 10-year KTB futures.

Over 10,000 random stochastic scenarios, the hedged claim coverage ratio was 99%, where the hedged claim ratio essentially measures the insurance company's ability to meet its claims obligations. It is defined as the ratio of the sum of AV, excess claims, cumulative hedge premiums, and the negative of the cumulative transaction cost to the sum of the excess claims and AV.

### Bearish market scenario

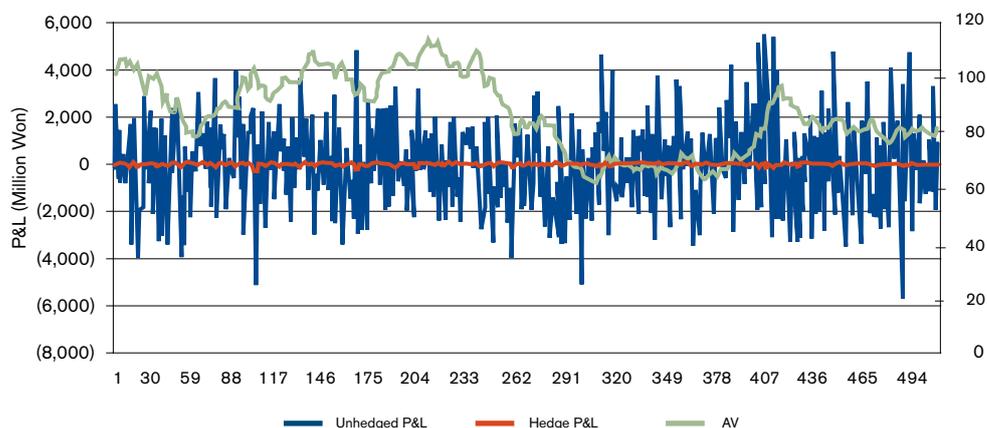
Let us consider a severe scenario where AV drops by 20% of the initial AV over 10 years. The hedged claim coverage ratio is 97%, while the unhedged claim coverage ratio is 77%. The net P&L and P&L volatility are summarized in the table in Figure 18. The volatility reduction is 98%. Because of the market crash, KRW 32 trillion of hedge gain occurs over 10 years. The hedged and unhedged net P&L along with the market movement over 10 years are displayed in Figure 19. There is a significant reduction in P&L volatility.

Let us consider a severe scenario where AV drops by 20% of the initial AV over 10 years. The hedged claim coverage ratio is 97%, while the unhedged claim coverage ratio is 77%.

FIGURE 18: NET P&L AND P&L VOLATILITY UNDER A DOWN SCENARIO

	UNHEDGED	HEDGED
NET P&L	(36,956,251,418)	(5,049,306,593)
P&L VOLATILITY	1,865,927,595	44,853,526

FIGURE 19: NET P&L: HEDGED VS. UNHEDGED



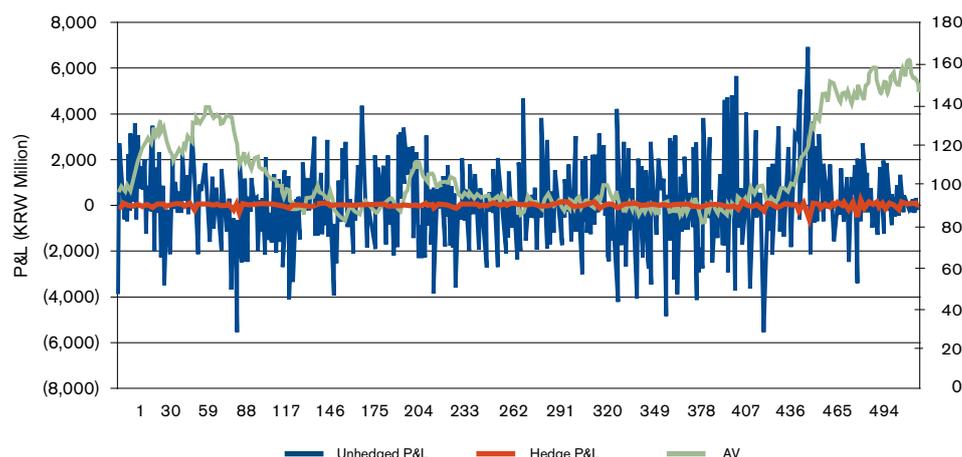
### Bullish Market Scenario

For an up scenario, we consider a situation where the AV increases by 40% over 10 years. The hedged claim coverage ratio is 100%, while the unhedged claim coverage ratio is 121%. The P&L volatility is reduced by 96% (see the table in Figure 20). Because of the upward market movement, the hedging strategy bears a loss as expected. The hedged and unhedged P&L and the market movement for the entire period are displayed in Figure 21.

FIGURE 20: NET P&L AND P&L VOLATILITY UNDER AN UP SCENARIO

	UNHEDGED	HEDGED
<b>NET P&amp;L</b>	<b>42,257,186,495</b>	<b>1,139,301,637</b>
<b>P&amp;L VOLATILITY</b>	<b>1,800,451,643</b>	<b>76,161,930</b>

FIGURE 21: NET P&L: HEDGED VS. UNHEDGED



In summary, a dynamic hedging strategy performs effectively for our hypothetical block of business. Based on this analysis, dynamic hedging is a desirable risk management strategy for Korean VA products.

### Issues on the implementation of hedging programs in Korea

Although a dynamic hedging strategy is recommended as a good risk management strategy to Korean VA writers, there are several practical issues in the implementation process:

- **IRS usage:** The large interest rate exposure of Korean VA products is mainly due to the long maturity of the products and a large portion of recurring-premium-type products. To efficiently manage interest rate risk in a dynamic hedging scheme, highly liquid interest rate derivatives with appropriate duration must be utilized. That is, long-term interest rate derivatives are needed. However, long-term KTB futures such as 10-year are not actively traded, and even longer maturity KTB futures do not exist in the Korean futures market. Under this current Korean bond futures market circumstance, the use of 10-year or even longer maturity IRS seems necessary. The trading volume of long-maturity IRS relies on the size of the in-force business.
- **Regulatory ambiguity of IRS use:** Under the Korean capital market consolidation act (KCMCA), the trading volume of IRS is limited to 15% of the AV for insurance companies. But the limitation will not be applicable if IRS trading is for hedging purposes. In practice, the legislation has never

**A dynamic hedging strategy performs effectively for our hypothetical block of business. Based on this analysis, dynamic hedging is a desirable risk management strategy for Korean VA products.**

been enacted because none of the Korean insurance companies dynamically hedge their VA businesses, and the application of this regulation has been a source of controversy between those insurance companies that consider hedging and the Korean regulator. Given that the size of VA business is small relative to the entire business of insurance companies, the trading limit of IRS will not be an obstacle for most Korean VA writers, except for one or two major players that hedge their VA business at present.

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**The products that have aggressive international equity funds are actually troublemakers in hedging. If the size of those funds is small, it will be wise to set them aside from the hedge program.**

- **Use of sophisticated fund mapping models:** The products that have aggressive international equity funds are actually troublemakers in hedging. If the size of those funds is small, it will be wise to set them aside from the hedge program. Otherwise, one can consider a sophisticated fund mapping to minimize the basis risk caused by the mismatch between the international equity funds and benchmarks.
- **Devoted study on policyholder behavior:** To minimize policyholder behavior risk in a hedge program, a study on policyholder behavior for a fairly long period time is necessary. Companies can also benefit from dynamic policyholder modeling to account for the unique characteristics of Korean customers.
- **Knowledgeable and experienced experts needed:** The principle of dynamic hedging may be intuitive to understand. However, an efficient hedging program requires the modeler and the hedger to have a comprehensive understanding of both capital markets and insurance markets. In order to minimize the model risk and successfully implement the hedge program, dedicated, knowledgeable, and experienced professionals are needed.
- **Highly efficient operational system requirement:** Dynamic hedging is to offset the liability payoff continuously, so it demands a high level of stochastic valuation. For instance, a study on the hedge effectiveness requires a stochastic-on-stochastic valuation, and it needs to be a seriatim valuation. Such a stochastic-on-stochastic and seriatim valuation results in a large amount of computational burden. To resolve the computational difficulty, an efficient operational system is essential.

## CAPITAL AND RESERVE REQUIREMENT

In the United States, the C-3 Phase II (C3P2) regulatory standard was introduced in 2005 to manage market risks associated with VA guarantees. It is a principles-based (or stochastic) approach to determining minimum capital requirements. The required amount of capital is defined by the greater of either the conditional tail expectation at a 90th percentile (CTE90) or the standard scenario amount (SSA).

For a reserving standard, the actuarial guideline covering the Commissioners' Annuity Reserving Valuation Method for variable annuities (AG VACARVM) was proposed in 2005, but not finalized to be effective until 2008. In September 2008, AG VACARVM, known as AG 43, was finally adopted by the National Association of Insurance Commissioners (NAIC), and the implementation will be effective on December 31, 2009. AG 43 reserve is defined as the SSA plus the excess of CTE70 amount over SSA, if any.

The basics of both C3P2 and AG 43 are similar. Both are principles-based valuation standards, with stochastic requirements and a deterministic floor (SSA), and both give a credit for approved hedging programs. Only slight differences exist in assumptions used for the stochastic valuation such as tax treatment or discount rate and in SSA valuation methodology.

Unlike in the United States, Korean reserve and required capital amounts of VA are based on a pre-determined scenario only. Required capital amount for VA is 2% of AV minus reserve. VA writers hold the reserve amount of the accumulated fees at a crediting rate, plus the excess of the accumulated fees, if any, over the minimum guarantee reserve under the current regulation. The minimum guarantee reserve is the present value of the loss under the predetermined, extreme scenario.

**Unlike in the United States, Korean reserve and required capital amounts of VA are based on a pre-determined scenario only.**

The current reserving standard has limitations. First, it does not provide a standard to evaluate the sufficiency of the reserve to future losses because it is based only on one deterministic scenario. Second, there is no one consistent standard applicable to all companies. For instance, the current regulation does not state the detailed guideline of evaluating the minimum guarantee reserve, so the assumptions for a deterministic scenario vary by companies. Third, because there is no regulation of accounting treatment for the reserve, companies could apply different accounting treatments for the reserve.

However, the reserve regulation task force was formed by the Financial Supervisory Service (FSS) in early 2009 to enact a new reserving standard for VA products. It is informally known that the new regulation will stress the importance of a stochastic approach in the reserving valuation. It will consist of a stochastic amount based on CTE and a deterministic floor and may credit approved hedging strategies. Given this anticipation, the general structure of the new standard will be similar to the U.S. regulation. The anticipated effective date of the new regulation is the first half of 2010.

A stochastic valuation is computationally intensive, and demands long computing time. Despite its challenges, it has several advantages: It allows insurance companies to consider all possible future scenarios, and it provides the distribution of future cash flow. In particular, the CTE amount is superior to value at risk (VaR) in the sense that CTE can measure the size of the future loss and the frequency of the future extreme events, while VaR only measures the frequency of the extreme events.

The adoption of the stochastic valuation in reserving in Korea is also in line with the global trend in the insurance business. The United States, Canada, and Europe already accept the stochastic valuation in reserving, and the reasonableness has been proved. Regulations in those countries have evolved to cover all of the possible risks associated with insurance products, such as market risks, operational risks, and credit risks. To successfully achieve this goal, stochastic modeling is highly recommended.

If a new reserving regulation based on a stochastic approach becomes effective in Korea, Korean VA writers need to prepare for a large amount of stochastic-on-stochastic-based seriatim valuation. It will require complex modeling, an efficient valuation tool, and an analyzing ability.

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**The impact of a stochastic reserve amount on the insurance companies' balance sheets will be material, especially for the products developed without the consideration of risk management.**

The impact of a stochastic reserve amount on the insurance companies' balance sheets will be material, especially for the products developed without the consideration of risk management. The actual significance of materiality will depend on product designs and the level of CTE designated by the regulator.

## CASE STUDY: STOCHASTIC VALUATION IN RESERVE AND REQUIRED CAPITAL

We valued a CTE amount using U.S. regulations and accumulated fees in current Korean reserving methodology. In the U.S. approach, we calculated before-tax CTE amount at different levels.

A sample product was 100% ROP GMAB/GMDB with 10-year maturity. It was a monthly premium type, and the deposit period was five years. The fund allocation was 50/50 in the domestic equity (KOSPI 200) and bond (3-year KTB). The typical loadings and fee structures were assumed. No tax treatment was incorporated.

In Korea, these types of products are sold for 55 bps. This cost may have been reasonable before the financial crisis in 2008, but it is no longer sufficient under the current market environment of low interest and high volatility. Based on our pricing, the cost of this product is 1.46%. To reflect the current market changes, a cost higher than 55 bps seems more appropriate. In our study, we compared the reserve amounts for two different rider charges of 55 bps and 75 bps to understand how the reserve amount changed by a rider charge.

The monthly premium amount is KRW 500,000, and so the annual premium amount is KRW 6 million.

Stochastic scenarios were generated under the Korean capital market assumptions. As of Q2 2009, the annual realized volatility of KOSPI 200 was 34.5%, and that of 3-year KTB was 5.1%. The average forward rate over 10 years was 4.2%.

### Analysis by rider charges

We calculated CTE amounts in different levels from 60 to 90. KRW 29.9 million of the expected total premiums (after-fee) as the current AV was used to obtain the percentage CTE relative to AV.

The table in Figure 22 summarizes the before-tax CTE amount by different levels of the hedge effectiveness in different levels, when 55 bps of the rider charge is assumed. CTE60 with no hedging credit is about KRW 1.9 million, which is 6.39% of the AV over the lifetime of the product. As the hedge effectiveness increases, the CTE amount at any level decreases exponentially. Under 70% of the hedge effectiveness, CTE60 is only 1% of the AV and no reserve is required when a hedge program is working perfectly. Also, the CTE amount increases as the level increases. The size of the increase depends on the level of the hedge effectiveness. For our hypothetical block of business, CTE90 is on average three times as large as CTE60.

We valued a CTE amount using U.S. regulations and accumulated fees in current Korean reserving methodology.

FIGURE 22: BEFORE-TAX CTE FOR 55 BPS RIDER CHARGE (UNIT: KRW)

CTE LEVEL	HEDGE EFFECTIVENESS							
	0%		50%		70%		100%	
	CTE	%AV	CTE	%AV	CTE	%AV	CTE	%AV
60	1,914,472	6.39%	703,224	2.35%	262,317	0.88%	-	0.00%
70	2,535,413	8.47%	937,632	3.13%	349,756	1.17%	-	0.00%
80	3,347,725	11.18%	1,331,080	4.45%	524,583	1.75%	-	0.00%
90	4,415,649	14.75%	1,862,631	6.22%	841,566	2.81%	-	0.00%

Similar results, given in the table in Figure 23, are obtained when the rider charge is assumed to be 75 bps. Compared with the 55 bps rider charge case, CTE amounts are reduced by 0.35% on average where no hedge credit is assumed. The size of the reduction decreases as the hedge effectiveness increases.

**FIGURE 23: BEFORE-TAX CTE FOR 75 BPS RIDER CHARGE (UNIT: KRW)**

CTE LEVEL	HEDGE EFFECTIVENESS							
	0%		50%		70%		100%	
	CTE	%AV	CTE	%AV	CTE	%AV	CTE	%AV
60	1,815,119	6.06%	665,911	2.22%	246,008	0.82%	-	0.00%
70	2,416,426	8.07%	887,881	2.97%	328,010	1.10%	-	0.00%
80	3,239,077	10.82%	1,276,367	4.26%	492,015	1.64%	-	0.00%
90	4,315,452	14.41%	1,812,168	6.05%	810,934	2.71%	-	0.00%

To study the impact of a stochastic requirement in reserving, we compared the accumulated fees at inception, which is the reserve requirement under the current Korean regulation, with the before-tax CTE60 for different rider charges, given in the table in Figure 24; 3% of a crediting rate is assumed. When the rider charge is 55 bps, CTE60 is 12.3 times as large as the accumulated fees. This is a material change in a reserve amount, but the actual amount of CTE will vary by the types of products, types of in-force blocks, types of premium, deferral periods, deposit periods, sex, age, etc. For 75 bps of the rider charge, the size of the increase is smaller, 8.6 times the accumulated fees.

#### Analysis by methodology

To study the impact of a stochastic requirement in reserving, we compared the accumulated fees at inception, which is the reserve requirement under the current Korean regulation, with the before-tax CTE60 for different rider charges, given in the table in Figure 24; 3% of a crediting rate is assumed. When the rider charge is 55 bps, CTE60 is 12.3 times as large as the accumulated fees. This is a material change in a reserve amount, but the actual amount of CTE will vary by the types of products, types of in-force blocks, types of premium, deferral periods, deposit periods, sex, age, etc. For 75 bps of the rider charge, the size of the increase is smaller, 8.6 times the accumulated fees.

**FIGURE 24: CTE AMOUNT VS. ACCUMULATED FEES**

RIDER CHARGE	ACCUMULATED FEES AT ISSUE	CTE(60)	RATIO
55 BPS	155,664	1,914,472	12.3
75 BPS	212,269	1,815,119	8.6

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## FUTURE PERSPECTIVE ON THE KOREAN VA MARKET

To confront the new market circumstances, Korean VA writers cannot avoid moving their businesses in new directions. The possible improvements in terms of product development and risk management are given below.

- **A hedge-in-fund strategy:** A *hedge-in-fund* is a fund in which an internal hedging program is embedded in the funds of VA products. The internal hedging strategy can be determined by the purpose of hedging. Because a hedge program is internally implemented, the hedge cost will be reduced. Thus, this is one way of offering lower fees with more competitive guarantee design. The lower fees will enhance the sale of VA products. More sophisticated strategies can be incorporated with a *hedge-in-fund* strategy.
- **Volatility management strategy:** Many Korean VA products are exposed to a large equity risk. This is because of a large portion of equity in funds, such as 50%. In fact, a high volatility is often a critical obstacle for VA writers to price their products, so a stable volatility will help VA writers to introduce more competitive products (i.e., low rider charges with the similar richness of the benefit) into the market. To manage the level of the volatility, one can add a volatility management strategy in the internal hedging program in a *hedge-in-fund*. This can be implemented by setting a level of target volatility per portfolio type, and frequently adjusting the allocation of funds in the portfolio to maintain the target volatility level.
- **Capital protection strategy:** Korean VA markets are expecting to adopt a new reserving regulation, or possibly required capital amount. If stochastic valuation is applied in a reserve/required capital calculation, VA writers will attempt to minimize the impact of the new regulation on their balance sheets and income statements. However, under the current market condition, the impact may be material. As a method of stabilizing the fluctuation of the minimum capital amount, one can incorporate a capital protection strategy into a *hedge-in-fund*. This is to determine the fund allocation depending on the risk tolerance of insurers simultaneously with performing an internal hedging and managing the target volatility level. Thus, the minimum capital amount will be locked at a certain level. In addition, embedding a hedge program within funds, one can control the account value against the extreme market movement. This will allow VA writers to develop more competitive and marketable products with reasonable, low costs.

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**A high volatility is often a critical obstacle for VA writers to price their products, so a stable volatility will help VA writers to introduce more competitive products into the market.**

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## CONCLUSIONS

The Korean VA market has a great growth potential, although the global market upheaval has significantly affected the VA market environment. The sales volume in new business has dropped dramatically, and the size of existing business has also shrunk. This underlines the importance of effective risk management.

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**In considering the unique characteristics of Korean VA products and the Korean capital market condition, dynamic hedging is one of the best risk management strategies for Korean VA writers.**

In considering the unique characteristics of Korean VA products and the Korean capital market condition, dynamic hedging is one of the best risk management strategies for Korean VA writers. However, the implementation of a hedging program requires dedicated human resources and an efficient operation system.

The new reserving standard based on a stochastic valuation could be effective early in 2010. Our analysis shows that the CTE60 is 12.3 times larger than the present value of the accumulated fees, which is defined by the current Korean regulation, for our sample block of business. However, the actual size of the impact will vary by different blocks of businesses, premium types, deferral periods, etc.

The Korean VA market changes in the same fashion as the global VA market. The latest capital market downturn and the new regulatory requirement inspire the VA writers to seek new challenges. For instance, a hedge-in-fund with a volatility management and a capital protection can be useful to the Korean VA writers to enhance their VA business, and thus trigger a big turning point for future Korean VA business.

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## REFERENCES

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Milliman, whose corporate offices are in Seattle, serves the full spectrum of business, financial, government, and union organizations. Founded in 1947 as Milliman & Robertson, the company has 52 offices in principal cities in the United States and worldwide. Milliman employs more than 2,400 people, including a professional staff of more than 1,100 qualified consultants and actuaries. The firm has consulting practices in employee benefits, healthcare, life insurance/financial services, and property and casualty insurance. Milliman's employee benefits practice is a member of Abelica Global, an international organization of independent consulting firms serving clients around the globe. For further information visit [www.milliman.com](http://www.milliman.com).

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