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# The Relative Importance of Asset Allocation and Security Selection

**Kodjovi Assoé**
**Jean-François L'Her**
**Jean-François Plante**

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**Kodjovi Assoé**

***Associate Professor, Finance Department***
***HEC Montréal and CREF***

*3000, chemin de la Côte-Sainte-Catherine*
*Montréal, Québec, CANADA H3T 2A7*
*E-Mail: kodjovi.assoe@hec.ca*

**Jean-François L'Her**

***Vice-President, Investment Policy Research***
***Caisse de dépôt et placement du Québec***

*1000, Place Jean-Paul Riopelle, 9th Floor*
*Montréal, Québec, Canada H2Z 2B3*
*E-Mail: jlher@lacaisse.com*

**Jean-François Plante**

***Senior Adviser, Investment Policy Research***
***Caisse de dépôt et placement du Québec***

*1000, Place Jean-Paul Riopelle, 9th Floor*
*Montréal, Québec, Canada H2Z 2B3*
*E-Mail: jfplante@lacaisse.com*



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# The Relative Importance of Asset Allocation and Security Selection


**Abstract**

We revisit the debate on the relative importance of asset allocation and security selection activities over the 1985-2005 period, within the Kritzman and Page (KP, 2003) normative framework. We use a more representative opportunity set for asset allocation, an unbiased dataset for stocks, and a modified security selection methodology which ensures strict uniformity with asset allocation rebalancing rules. Unlike KP, our results do not support a clear hierarchy of investment choice. The extent to which each activity generates dispersion in active return is time-dependent.



**Keywords:** Asset allocation, Security selection, Investment activity

**JEL Classification:** G11


# Importance relative des activités de répartition d'actif et de sélection de titres


## Résumé

Nous réexaminons la question de l'importance relative des activités de répartition d'actif et de sélection de titres sur la période 1985-2005 dans le cadre de l'approche normative de Kritzman et Page (KP, 2003). Nous utilisons un ensemble plus représentatif de l'univers d'investissement pour la répartition d'actif, des données boursières non biaisées, et une nouvelle méthodologie de sélection de titres strictement conforme à celle de la répartition d'actif. Contrairement à KP, nos résultats ne supportent pas une hiérarchie claire entre les activités d'investissement. Le niveau de dispersion des rendements excédentaires générés par chaque activité varie dans le temps.



**Mots-clés :** Répartition d'actif, sélection de titre, activités d'investissement

# Introduction

The common belief that asset allocation is superior to other investment activities originates from the 1986 article by Brinson, Hood and Beebower (BHB). The frequently cited conclusion of both this article and its updated version five years later by Brinson, Singer and Beebower (BSB) is that strategic asset allocation accounts for over 90% of the variation in the performance of 91 pension plans over a ten-year period.[1] However, as emphasized by Kritzman and Page (2003) (hereafter, KP), and recently illustrated by Kritzman (2006), it could be quite hazardous to draw any conclusion on the relative importance of security selection and asset allocation using the methodological approach adopted by BHB/BSB.[2] Kritzman (2006, p.10) provides a simple numerical example to demonstrate that "*most of the variation that they* [BHB/BSB] *attributed to asset allocation arose not from the choice of the portfolio's asset mix but, instead, from the* [only] *decision to invest* [in anything]".

The debate on the relative importance of asset allocation and security selection recently took a new turn when KP adopted a normative approach based on a bootstrap simulation to establish the hierarchy of such investment activities. Their approach is designed to disentangle investor behavior from investment opportunity, as it is based on *potential*, rather than *realized* portfolio returns. In fact, normative economics – as opposed to positive studies – explore which investment choice has the greatest potential to influence investment results rather than focus on what investors chose to do. KP (2003, p. 22) essentially find that "*[…] asset allocation is the least important investment activity […] and security selection is the most important investment choice*".[3] Those results are important and challenge conventional wisdom. KP argue that investors, for a variety of reasons, tend to hug certain benchmarks and avoid engaging meaningfully in security selection. Some critics, notably

Staub (2004), claim that the authors implicitly harness asset allocation. Staub also questions the normative status of KP's work for arbitrarily establishing the asset mix benchmark at 60% stocks, 30% bonds and 10% cash. KP (2004) provided a response to each of Staub's critiques, notably showing that allowing for greater asset allocation bets within their framework does not invalidate the hierarchy previously observed. Our study to a large extent follows KP's normative approach and builds on their bootstrapping methodology.

Our contribution to the debate on the relative importance of asset allocation and security selection in the U.S. market is concentrated along the following four dimensions. Firstly, we introduce a more representative benchmark portfolio to provide a better understanding of the relative importance of both activities. While KP used 60% stocks, 30% bonds and 10% cash, we believe that in the current investment environment, practitioners consider a broader spectrum of asset classes comprising traditional as well as non-traditional classes. Indeed, the 2005-2006 Russell Survey on Alternative Investing, published by the Russell Investment Group, points out that in 2005, North American tax-exempt organizations allocated 21.4% of their portfolio to alternative investments.[4] Moreover, it suggests that given the general trend observed, this allocation could reach 24.0% in 2007. To account for this broader investment opportunity set, we construct a benchmark portfolio that includes non-traditional asset classes such as real estate, private equity, and commodities. Secondly, we assess and improve the security selection methodology used by KP. In line with Staub's remarks and the response provided by KP (2004), we strictly apply the same rebalancing rules for both asset allocation and security selection. Thirdly, we lay emphasis on the time-series behavior of the cross-sectional dispersion in active returns rather than only on the average cross-sectional dispersion over the entire investment period. In so doing, we are able to investigate the stability of the hierarchy of investment choices over time. Lastly, we pay particular attention to the equity database (S&P 500 stocks) by avoiding any survivorship bias, and extend the analysis to a twenty-year period ending in June 2005.

# Data and Methodology

## Data

In their widely discussed paper, KP (2003) generated portfolios with asset mixes varying randomly around 60% stocks, 30% bonds and 10% cash. This asset allocation is legitimate, but we examine another asset allocation benchmark which is more in line with the broader spectrum of asset classes available to institutional investors. This spectrum comprises traditional as well as non-traditional classes, namely, real estate, private equity, and commodities, among others. We examine the relative importance of asset allocation and security selection using a benchmark portfolio which is 75% invested in traditional asset classes and 25% in non-traditional classes. The first two columns of **Exhibit 1** show the asset classes chosen to represent our benchmark portfolio and the weight given to each one.[5] The sources of the data used are presented in the third column, and descriptive statistics for each asset class appear from the fourth column.

***<Insert Exhibit 1 about here>***

For the security selection analysis, we lay particular emphasis on the construction of the database. Rather than picking only stocks listed in the current S&P 500 index, we carefully construct a database free of any survivorship bias. We retain the exact 500 constituents of the index for each month of the July 1985-June 2005 period. From a normative perspective particularly, the reconstitution done here is important and represents an improvement over what has appeared in previous studies. Indeed, only 198 of the current 500 constituents made the 1985 S&P 500 index. The spread between the true index and the index reconstructed from the 198 constituents is as wide as up to 567 basis points in 1991 and as low as -315 basis points in 1993.[6]

## Asset Allocation Methodology

Except for the notable change in the investment opportunity set for asset allocation, we use a bootstrapping methodology similar to KP (2003). That means we randomly choose an asset mix at the beginning of each of the twenty annual periods, starting in July 1985, and compute the corresponding return over the next four quarters. We obtain a time-series of 80 quarterly portfolio returns. We then repeat this experiment 10,000 times, with each repetition representing one sample portfolio. In choosing a random asset mix, we proceed as in KP (2003). We make 100 draws with replacement, each draw representing one percent of the portfolio, from a pool of six asset classes, in the following proportions (see Table 1): 5% cash, 30% bonds, 40% stocks, 10% real estate, 10% private equity, and 5% commodities. To appraise the portfolios generated by this bootstrapping procedure, we provide in **Exhibit 2** the distribution in the sample portfolio weights of two asset classes - stocks and real estate - along with their respective benchmark portfolio weights.

***<Insert Exhibit 2 about here>***

Exhibit 2 shows that the asset allocation drawing method assigns to stocks a random weight of around 40%, ranging from 18% to 61%. However, in 95% of cases, the stock weight ranges from 30% to 50%, representing a ±10% bet. For real estate, the random weight varies around 10%, between 1% and 22%. In 95% of all cases, real estate weights vary between 4% and 16%, representing a ±6% bet.

While we retain a wider investment opportunity set containing alternative asset classes, Exhibit 2 confirms that the asset allocation method used by KP does not tightly anchor sample portfolios as much as some critics have implied. We believe that asset allocators can extend their bets through these reasonable ranges and, contrary to Staub (2004), we are confident of the normative aspect of such rebalancing rules.

To determine the importance of the asset allocation activity through time, we measure the dispersion in the performance of the 10,000 sample portfolios resulting from the different asset mixes randomly derived from distributions, as illustrated in Exhibit 2. The more dispersed the performance of the sample portfolios, the more asset allocation should be seen as important. KP (2003, p.16) underline that dispersion is important to both skilful and unskilful investors; to the former because "*it enables them to increase wealth beyond what they could expect to achieve from average performance,*" and to the latter because "*it exposes them to losses that might arise.*"

## Modified Security Selection Methodology

As emphasized by KP (2004) in their response to Staub's (2004) comments, uniform rebalancing rules are essential in order to establish a comparison between two investment choices. Thus, we design a modified security selection methodology that ensures strict uniformity with the asset allocation methodology: with the asset mix established according to Exhibit 1, we generate 10,000 sample portfolios annually, and record their returns over the four subsequent quarters. For each portfolio, we randomly select 100 stocks with replacement, with each constituent of the S&P 500 being assigned a probability equal to its weight in the index (same method as for asset allocation). By contrast, KP use a sequential rule: they randomly select 100 stocks with replacement, with each constituent being assigned an equal probability, and then rescale returns according to their relative market capitalizations. Both methods differ with respect to the probability of selecting a stock and to the weight assigned to each selected stock within the sample portfolios. Consequently, the weight dispersion among large stocks within portfolios is significant, whether it is our methodology or that of KP that is used.

To illustrate the differences between both security selection methodologies, consider a fictitious stock (ABC), with a 10% weight, in a 500 constituents' stock index, and assume that the 499 other stocks in the index are equally weighted ($\frac{90\%}{499}$ each). The probability of randomly picking ABC *x* times out of *n*=100 draws with replacement under the binomial distribution is given by:

$$f(x; n, p) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$$

Both security selection methods differ in terms of the probability, *p,* of picking ABC at each draw. Under our security selection method, the probability, *p,* is equal to the actual ABC weight in the index, that is 10%. By contrast, with the KP security selection method, the probability, *p,* is equal for each stock, that is $\frac{1}{500}$, since the stock index does have 500 constituents. **Exhibit 3** provides the probability of picking ABC *x times* out of 100 draws under both methodologies. As an example, the probability of randomly picking ABC twice *[f(2;100,*10%*)]* is 0.162% with our methodology, while with KP's *[f(2;100,*1/500*)],* it is 1.627%.

Both security selection methods also differ with respect to the way the weight of ABC is calculated in the sample portfolios. Under our security selection method, the weight of ABC is given by the number of occurrences, *x*, divided by the number of draws, *n*. With the KP security selection method, the weight of ABC in a random portfolio is a function of the respective index weights of ABC (10%) and of the other randomly selected stocks ($\frac{90\%}{499}$). Exhibit 3 provides the weight of ABC in the sample portfolio, given ABC has been picked *x* times out of 100 draws under both methodologies. As an illustration, the weight of ABC in the portfolio, given that ABC has been selected twice out of 100 draws, is equal to 2% in our case, while it is 53.1% for KP.

Within our methodology, the weight associated with ABC varies around 10%, from 2% to 20%. For KP, the weight associated with ABC is either 0% for 81.9% of the sample portfolios, or 35.9% or higher, for 18.1% of the sample portfolios (see Exhibit 3). The KP dispersion is much larger than ours, with the standard deviation being 14.7% with their method, and 3% with ours.

***<Insert Exhibit 3 about here>***

Based on actual S&P 500 data as of June 30, 2005, **Exhibit 4** shows the distribution of actual weights assigned to General Electric (GE), the largest S&P 500 constituent, within the two frameworks.

***<Insert Exhibit 4 about here>***

Our security selection methodology assigns GE, which accounts for 3.31% of the S&P 500 index at the end of June 2005, a random weight ranging from 0% to 12%; by contrast, KP's original method assigns a weight ranging from 0% to 46% to GE, a much wider range. What is troubling in this last observation is that, firstly, a sample portfolio can be heavily loaded with just a single stock possibly weighting as much as 46%, and secondly, 82% of the time, the largest S&P 500 stock is not included in the sample portfolio. In 18% of cases, when it would be included, its weight ranges from 11% to 46%. KP's original method looks like a binary scheme for larger stocks: either zero or a very large weight.

**Exhibit 5** reports the probabilities of assessing a zero weight in a sample portfolio to the group of the *i* largest constituents of the S&P 500 as of June 30, 2005.

***<Insert Exhibit 5 about here>***

Our results show that sample portfolios could be zero-weighted for each of the three largest companies (General Electric, Exxon Mobil, and Microsoft, representing 9% of the index) nearly 55% of the time, based on the KP security selection approach. Furthermore, 13.3% of the time, a sample portfolio could possibly include none of the ten largest companies in the index, which are firms that represent more than 21% of the index. By comparison, with our methodology, which ensures that the security selection method is exactly similar to the asset allocation method, the probability of not including any of the ten largest stocks in a sample portfolio is negligible.[7]

# Results

## Asset Allocation

**Exhibit 6** shows the results of the asset allocation bootstrap analysis. Every quarter, we present the cross-sectional dispersion in the quarterly performance of randomly selected portfolios relative to the benchmark portfolio arising from different asset mixes. We report the $5^{th}$, $25^{th}$, $50^{th}$, $75^{th}$ and $95^{th}$ percentiles relative to the median. In other words, Exhibit 6 displays the extent to which a talented investor ($5^{th}$ percentile) would improve upon median performance by engaging in asset allocation. It also shows how far below the median performance an unskilled or unlucky investor ($95^{th}$ percentile) would perform by choosing this investment activity. The three quarters in which the asset allocation decision generated the most dispersion are highlighted.

***<Insert Exhibit 6 about here>***

Exhibit 6 shows three different periods: First, the 1985-1992 period, in which cross-sectional dispersion in sample portfolios was significant, and asset allocation could have been considered as an important activity. During this particular period, two major events occurred: the October 1987 stock market crash and the September 1990 Iraqi invasion of Kuwait, and the associated spike in oil prices. In the second instance, we observe the 1993-1996 period, during which there was a much smaller cross-sectional dispersion in the sample portfolios. During this period, asset allocation did not really have any impact on the overall performance of portfolios. The period can also be characterized as a relatively calm one without any really significant crises. Thirdly, there is the 1997-2005 period, where asset allocation clearly regains all its importance. Here also, the rising high tech bubble of the late 1990s and the associated crash during the first years of the new millennium underscore the importance of choosing the right asset class at the right time.

Over the entire period, the third quarter of 1990 (first Iraqi invasion crisis), the fourth quarter of 1987 (October 1987 stock market crash) and the fourth quarter of 1998 (high tech bubble) happened to be the three most important quarters for asset allocation activity. The difference between the fifth best sample portfolio out of one hundred and the fifth worst is more than 4.78% for the last three months of 1987, 5.02% for the third quarter of 1990, and 4.12% for the fourth quarter of 1998. On an annualized basis, over the whole twenty-year period of our study, the difference between the $5^{th}$ and the $95^{th}$ percentile sample portfolios for asset allocation was 0.8%, which is in line with KP's (2003) results over the 1987-2001 period.

## Security Selection

We report the cross-sectional dispersion in quarterly performance of randomly drawn portfolios in **Exhibit 7**. Unlike in Exhibit 6, the dispersion in this case arises from different security portfolios with the same asset mix rather than from different asset mixes with the same security portfolio. We highlight the quarter during which security selection generated the highest amount of cross-sectional dispersion.

***<Insert Exhibit 7 about here>***

The 1985-1998 period shows a relatively small and quite stable dispersion in sample portfolios performance. During this period, the average difference between the fifth best sample portfolio out of one hundred and the fifth worst is about 1.5% per quarter. Neither the October 1987 stock market crash, the first Iraqi crisis of 1990 nor the Russian default in August 1998 seemed to have affected the way security selection impacts the overall performance of portfolios. However, the high tech bubble (the 1999-2002 period) clearly produces a larger dispersion in portfolio performance, indicating a larger opportunity for security selection activity. The quarter with the largest dispersion indeed corresponds to the peak of the bubble (the last three months of 2000).[8] The difference between the 5th and the 95th percentiles during this quarter is 3.58%. On an annualized basis, over the entire twenty-year period of our study, the difference between the 5th and the 95th percentile sample portfolios for security selection is 0.8%, which is 68% lower than the average of about 2.5% obtained by KP over the 1987-2001 period.[9]

Like KP, we do not allow security selection in any asset class except stocks. It may be the case that security selection is more important than reported – both herein and in KP – owing to the cross-sectional dispersion of performance within other asset classes, especially to the wider dispersion within alternative asset classes such as real estate or private equity. The dispersion of relative returns associated with security selection in each of the six asset classes and their correlation structure are important elements to make a point. Except for stocks, we can not precisely estimate the cross-sectional dispersion of each of the five other asset classes considered, due to limited data availability on their respective opportunity sets.[10] However, given that the drivers of relative returns in each of the six asset classes are conceptually independent of each other – leading to low correlations between alpha activities (Waring and Siegel [2003]) – we believe that the dispersion when allowing security selection within the six asset classes should not be dramatically higher than the one generated through stocks only.

The next section summarizes and compares the findings for both asset allocation and security selection activities, using our modified security selection methodology and benchmark portfolio, and then controlling for KP’s benchmark portfolio.

## Asset Allocation Versus Security Selection

**Exhibit 8** illustrates the dispersions generated by both activities in a single graph. We portray the dispersion of the quarterly difference between the $5^{th}$ and $95^{th}$ cross-sectional percentile performances generated by the bootstrap simulated portfolios as induced by both asset allocation and security selection activities. The greater the difference, the greater the relative importance of a given activity.

***<Insert Exhibit 8 about here>***

Exhibit 8 reveals three main features: (1) the relative importance of asset allocation and security selection is time-dependent; (2) the asset allocation-driven dispersion is more volatile than the security selection-induced dispersion, and is especially sensitive to crises; and (3) the security selection activity generates as much dispersion in active return as asset allocation so that it cannot be unequivocally declared that one activity is structurally more or less important than the other. While the first two features are practically indisputable, the third needs some clarification.

It is important to emphasize that our results do not necessarily contradict those reported by KP - with KP, the security selection activity dominates the asset allocation activity. The difference is essentially attributable to two factors:[11] (1) the difference in security selection methodologies, and (2) the difference in benchmark portfolios – the KP benchmark portfolio comprises only traditional asset classes, while ours also comprises non-traditional ones, and consequently, a smaller fraction of stocks as well. The latter explains about a third of the difference in results, while the former explains the other two-thirds. In other words, if we were to repeat the simulations with our security selection methodology, but using KP's benchmark portfolio (60/30/10 stocks, bonds and cash), the difference in annualized performance between the 5th and the 95th percentile sample portfolios induced by security selection activity would be 1.3%, a figure which is higher than our reported average of 0.8%, but significantly lower than KP's average of 2.5%.[12] Consequently, the relative importance of security selection over asset allocation (1.3% - 0.8% = 0.5%) is reduced by two-thirds when compared to the original findings of KP (2.5% - 0.8% = 1.7%). By deduction, the benchmark portfolio difference is thus responsible for the other third of the difference in results.

# Conclusion

We re-examine the relative importance of asset allocation and security selection decisions. We use the normative approach introduced by Kritzman and Page (2003) and add to the literature on four fronts. Firstly, we extend the opportunity set from traditional asset classes only to a mix of traditional and alternative asset classes. Our benchmark portfolio – 25/40/30/5 non-traditional asset classes, stocks, bonds and cash – is more representative of 2006 asset mixes of North American tax-exempt organizations. Secondly, while the critics of KP's results often looked at the asset allocation side of the equation, blaming the authors for implicitly "harnessing" this activity, we focus on the security selection side. We design a modified security selection methodology which ensures strict uniformity with asset allocation rebalancing rules. Thirdly, we use an unbiased investment universe for the stock component of the portfolio, and, finally, we consider an up-to-date 20 year period ending in June 2005.

We demonstrate that KP's security selection methodology does not yield strict uniformity with the asset allocation rebalancing rules and implicitly produces very large active bets, either by completely ignoring as many as ten of the largest stocks in the SP&500 universe – with more than 20% of market capitalization – or by sometimes investing as much as 46% of a portfolio in a single stock. By contrast, our modified security selection methodology, which is in line with asset allocation rebalancing rules, generates significantly less dispersion in active returns.

Consequently, with the asset allocation opportunity set postulated by Kritzman and Page (2003) – 60/30/10 stocks, bonds and cash –, even though security selection could still be viewed as the most important activity, the relative importance of security selection over asset allocation would have been reduced by two thirds. With our more representative benchmark portfolio, and modified security selection methodology, our results do not support a clear hierarchy of investment choice. Security selection and asset allocation decisions are, on average, just as important. Further, the relative importance of asset allocation and security selection is largely time-dependent. The October 1987 crash and the first Iraqi invasion crisis in the third quarter of 1990 were especially important for asset allocation, while the high tech bubble of the late 1990s-early 2000s was important for both asset allocation and security selection. Our results thus indicate that it cannot be unequivocally declared that one particular activity is structurally more – or less – important than the other.

**Exhibit 1. Asset classes in the benchmark portfolio**

Weight of each asset class, source of data and annualized descriptive statistics (July 1985 through June 2005) are displayed.

| | | | Annualized descriptive statistics | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Weight** | **Asset classes** | **Source for data** | **Average geometric return** | **Standard deviation** | **Correlations (quarterly)** | | | | | |
| | | | | | Cash | Bonds | Stocks | Real estate | Private equity | Commodities |
| **5%** | **Cash** | Lehman 91 days T-Bills | 4.9% | 1.0% | 1.0 | | | | | |
| **30%** | **Bonds** | Lehman aggregate | 8.4% | 4.7% | 0.3 | 1.0 | | | | |
| **40%** | **Stocks** | S&P 500 | 12.4% | 16.6% | 0.1 | 0.0 | 1.0 | | | |
| **10%** | **Real estate** | NCREIF national property index | 7.6% | 3.1% | 0.0 | -0.1 | 0.0 | 1.0 | | |
| **10%** | **Private equity** | Venture Economics; time weighted pool average return; all private equity | 13.9% | 12.0% | 0.0 | -0.2 | 0.6 | 0.1 | 1.0 | |
| **5%** | **Commodities** | GSCI total return index | 11.5% | 20.8% | 0.1 | -0.2 | -0.2 | 0.1 | 0.0 | 1.0 |

**Exhibit 2. Distribution of the weights of the stock and real estate components in the sample portfolios generated by the bootstrap simulation**

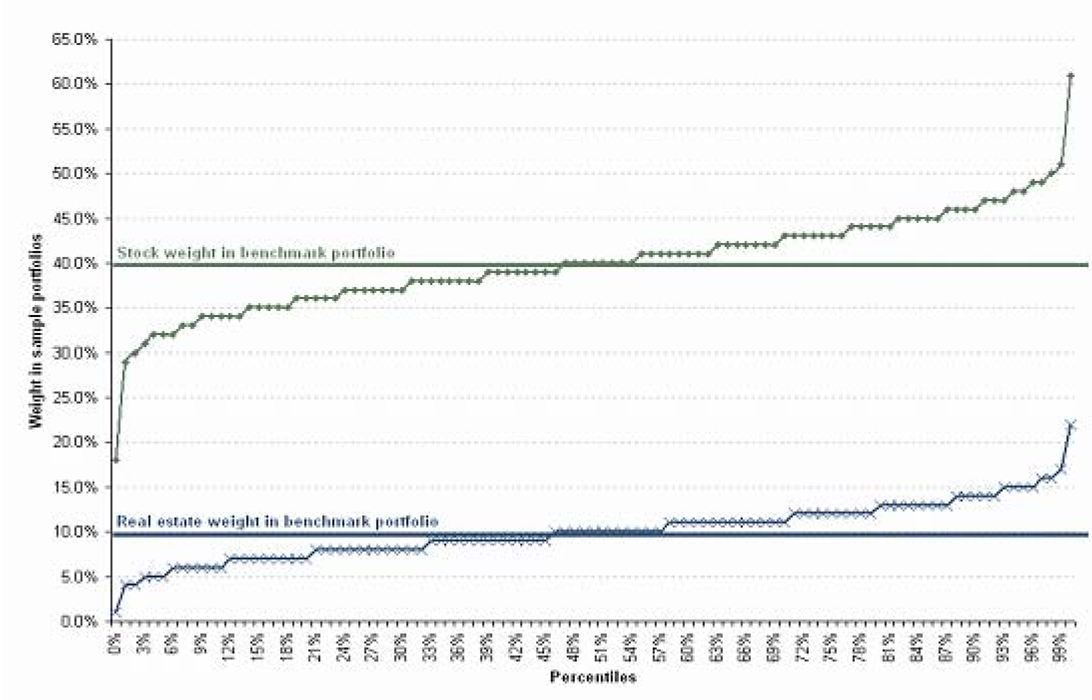


**Exhibit 3. Illustration of differences in security selection methodologies**

Probability of randomly selecting ABC *x* times out of 100 draws (*f(x;n,p)*) and weight of ABC in the random portfolio given *x* for KP's methodology and our modified security selection (MSS) methodology.

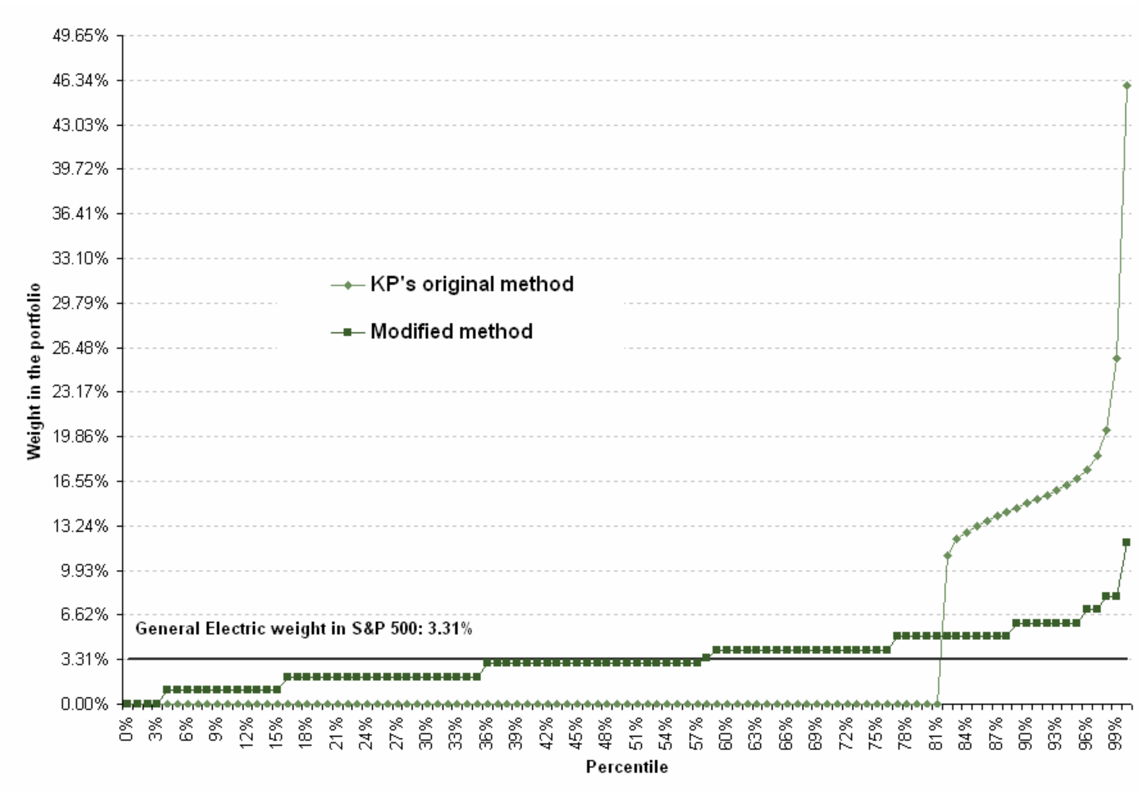
| | KP's methodology | | Modified methodology | |
|---|---|---|---|---|
| $x$ | $f(x;100,1/500)$ | $w_{KP}$ [a] | $f(x;100,10\%)$ | $w_{MSS}$ [b] |
| 0 | 81.857% | 0.0% | 0.003% | 0.0% |
| 1 | 16.404% | 35.9% | 0.030% | 1.0% |
| 2 | 1.627% | 53.1% | 0.162% | 2.0% |
| 3 | 0.107% | 63.2% | 0.589% | 3.0% |
| 4 | 0.005% | 69.8% | 1.587% | 4.0% |
| 5 | 0.000% | 74.5% | 3.387% | 5.0% |
| 6 | 0.000% | 78.0% | 5.958% | 6.0% |
| 7 | 0.000% | 80.7% | 8.890% | 7.0% |
| 8 | 0.000% | 82.8% | 11.482% | 8.0% |
| 9 | 0.000% | 84.6% | 13.042% | 9.0% |
| 10 | 0.000% | 86.0% | 13.187% | 10.0% |
| 11 | 0.000% | 87.3% | 11.988% | 11.0% |
| 12 | 0.000% | 88.3% | 9.879% | 12.0% |
| 13 | 0.000% | 89.2% | 7.430% | 13.0% |
| 14 | 0.000% | 90.0% | 5.130% | 14.0% |
| 15 | 0.000% | 90.7% | 3.268% | 15.0% |
| 16 | 0.000% | 91.4% | 1.929% | 16.0% |
| 17 | 0.000% | 91.9% | 1.059% | 17.0% |
| 18 | 0.000% | 92.4% | 0.543% | 18.0% |
| 19 | 0.000% | 92.9% | 0.260% | 19.0% |
| 20 | 0.000% | 93.3% | 0.117% | 20.0% |
| 21 | 0.000% | 93.6% | 0.050% | 21.0% |
| 22 | 0.000% | 94.0% | 0.020% | 22.0% |
| 23 | 0.000% | 94.3% | 0.007% | 23.0% |
| 24 | 0.000% | 94.6% | 0.003% | 24.0% |
| 25 | 0.000% | 94.9% | 0.001% | 25.0% |
| ... | ... | ... | ... | ... |
| **Sum** | 100.00% | | 100.00% | |
| **Standard deviation** | | **14.7%** | | **3.0%** [c] |

[a] $w_{KP} = (x \cdot 10\%)/[(x \cdot 10\%)+((100-x) \cdot 90\%/499)]$

[b] $w_{MSS} = x/100$

[c] $[p \cdot q/n]^{1/2} = 3.0\%$

**Exhibit 4. Distribution of the weights of General Electric in the sample portfolios , as of June 30, 2005**



## Exhibit 5. Probability of assessing a 0% weight to the *i* largest stocks, as of June 30, 2005

| | | | | | Probability of 0% weight | |
|---|---|---|---|---|---|---|
| i | Company | Market Value (M$) | Weight in S&P500 | Cumulative Weight in S&P 500 ($w_i$) | Modified methodology[a] | KP's methodology[b] |
| 1 | General Electric Co | 367 495 | 3.3% | 3.3% | 3.4% | 81.9% |
| 2 | Exxon Mobil Corp | 365 797 | 3.3% | 6.6% | 0.1% | 67.0% |
| 3 | Microsoft Corp | 268 371 | 2.4% | 9.0% | 0.0% | 54.8% |
| 4 | Citigroup Inc | 240 497 | 2.2% | 11.2% | 0.0% | 44.8% |
| 5 | Pfizer Inc | 205 067 | 1.8% | 13.0% | 0.0% | 36.6% |
| 6 | Wal-Mart Stores | 201 573 | 1.8% | 14.9% | 0.0% | 29.9% |
| 7 | Johnson & Johnson | 193 205 | 1.7% | 16.6% | 0.0% | 24.4% |
| 8 | Bank of America Corp | 184 051 | 1.7% | 18.3% | 0.0% | 19.9% |
| 9 | Intel Corp | 160 621 | 1.4% | 19.7% | 0.0% | 16.3% |
| 10 | American International Group | 150 764 | 1.4% | 21.1% | 0.0% | 13.3% |
| | **Ten largest** | **2 337 441** | **21.1%** | | | |
| | **S&P 500** | **11 096 711** | **100.0%** | | | |

a $p(w=0\%) = [1-w_i]^{100}$

b $p(w=0\%) = [1-(i/500)]^{100}$

**Exhibit 6. Asset allocation analysis: 5$^{th}$, 25$^{th}$, 75$^{th}$, and 95$^{th}$ percentile quarterly performances relative to median over the period of July 1985 through June 2005**

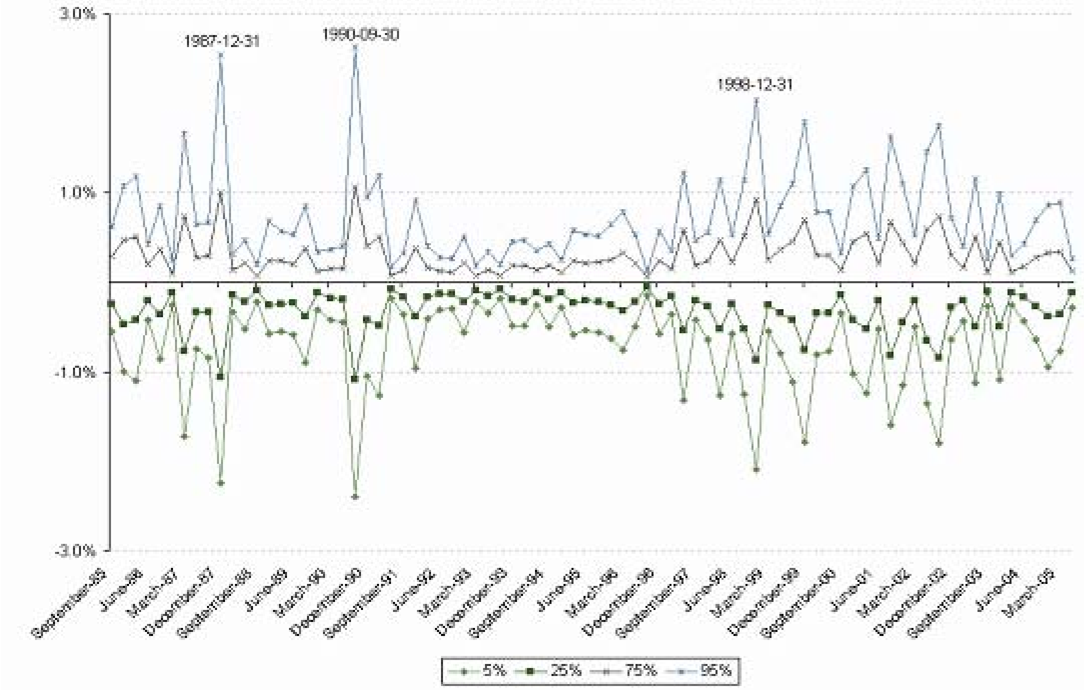


**Exhibit 7. Security selection analysis: 5th, 25th, 75th, and 95th percentile quarterly performances relative to median over the period of July 1985 through June 2005**

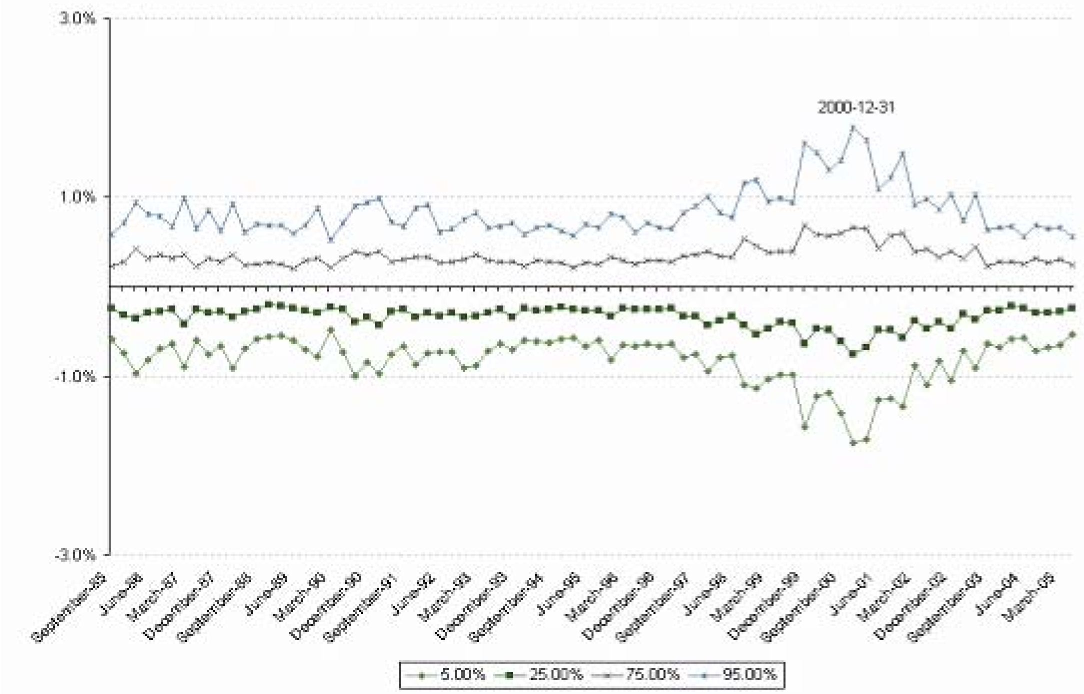
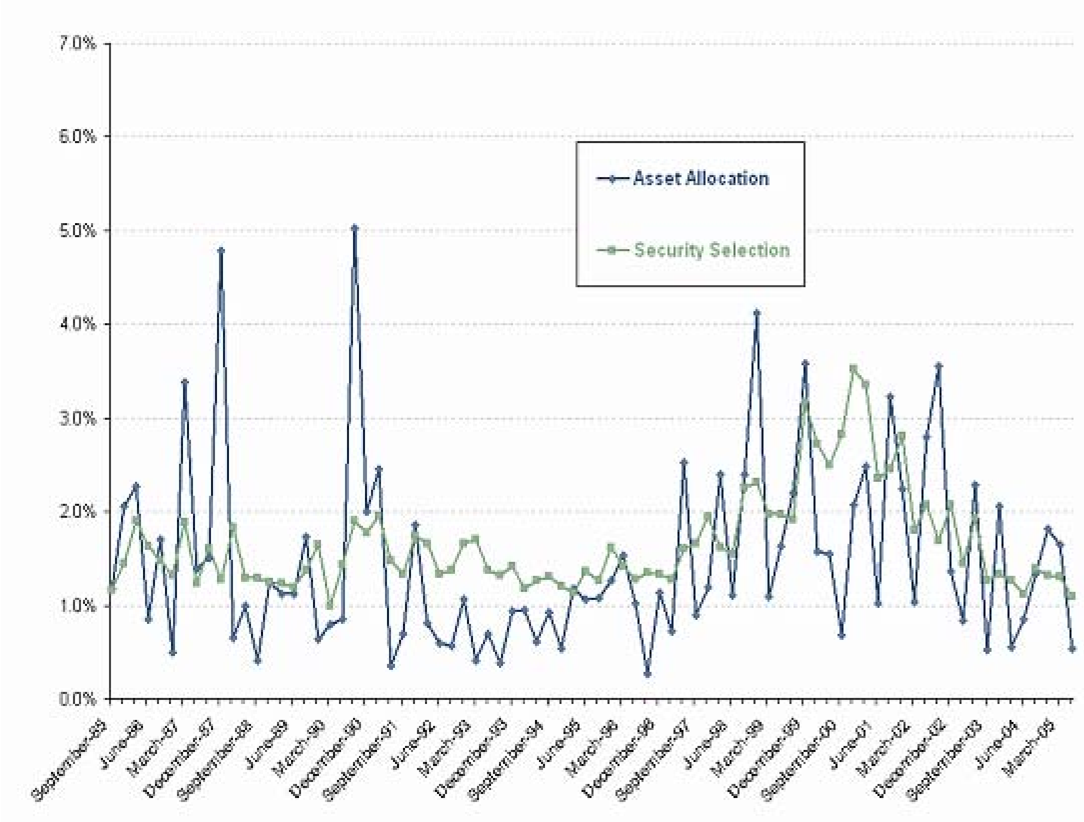


**Exhibit 8. Relative importance of asset allocation and security selection: difference between the 5th and 95th percentile quarterly performances**



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# ENDNOTES

[1] Ibbotson and Kaplan (2000) underscore the importance of assessing the right analysis to the right question, and warn against misinterpretation of BHB/BSB's results.

[2] See also the response of Brinson (2006) and Hood (2006).

[3] KP also examine the relative importance of country and industry choices, as well as security selection and sector selection using a broad universe: MSCI World. They also analyze the issue for five specific countries: Australia, Germany, Japan, the U.K. and the U.S. The hierarchy of investment choice always remains the same, with the most important activity being security selection, and the least important being the asset allocation decision.

[4] In the report, alternative investments correspond to private equity, real estate and hedge funds. Due to limited data availability, we do not include hedge funds in our study. However, we do include commodities, also an increasingly popular alternative asset class.

[5] For the sake of simplicity, we exclude foreign stocks from the benchmark. The split of the equity component of the benchmark portfolio into two separate indices for foreign stocks and domestic stocks would have very little impact on asset allocation results.

[6] Actually, KP (2003) use the MSCI index, not the S&P 500 index. Still, their data suffer from survivorship bias. To mitigate its effect, they recalculate an index with only the surviving stocks. While survivorship bias has no material impact on the stock selection activity, it may affect the asset allocation activity given the large spreads observed in 1991 and 1993.

[7] Differences in results whether we use KP or our security selection methodology would be much more contrasted if we focus on equity markets where concentration is a bigger issue (e.g. Finland or Sweden).

[8] De Silva, Sapra and Thorley (2001) provide evidence that the cross-sectional variation in U.S. realized returns during the bubble led to a correspondingly wide dispersion in realized fund returns. They argue that this increase in dispersion of fund performance is induced by increased security-return dispersion and "*has little to do with changes in informational efficiency of the market or range of management talent*" (p.29).

[9] We estimate the 2.5% from Exhibit 4 in KP (2003).

[10] Dispersion associated with security selection within bonds and cash is probably significantly lower than for stocks, while dispersion within real estate and private equity is probably higher. The dispersion associated with commodity security selection is probably between the dispersion observed for bonds and stocks.

[11] Other less material sources can explain the difference in results. The period of the study: 1987-2001 vs. 1985-2005, and the dataset for the stock component of the portfolios: MSCI with a survivorship bias in KP's vs. S&P 500 without survivorship bias are notable candidates.

[12] When limiting the asset allocation decision to stocks, bonds, and bills, our methodology tempers significantly KP's results, but do not invalidate them since the consistency of security selection dominance remains. For approximately 90% of the quarters, security selection dominates asset allocation.