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Dynamic strategies to optimize asset allocation: empirical evidence in the Brazilian market

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ABSTRACT: Short-term return bear influence on common investors and fund managers. However, the correct forecast of short-term market movements is not a trivial task. The purpose of this essay is to verify, according to Herold et al. (2007), if the dynamic allocation amongst main Brazilian asset classes can generate long-term gains and limit losses in shorter periods. The test results involving Ibovespa as the only risk asset confirmed this purpose. Tests involving fixed-income assets, variable-income assets and inflation-linked assets proved that the return is limited by this strategy. Static allocation and protection strategies were concurrently tested for short-term situations.

Keywords: Total Return, dynamic allocation, asset class, risk management.

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1. INTRODUCTION

Psychology has given us two important concepts to help understand why investors are currently so myopic when dealing with asset allocation. The first concept, presented by Tversky and Kahneman (1991), is loss aversion, indicating that investors are more susceptible to reductions than increases in their level of wealth. The second concept is mental accounting, which deals with methods used by investors to assess investment results.

Regarding the first concept, since daily returns on investment are negative much more often than annual return for fixed-income assets; investors with too much loss aversion tend to sell them or to change the portfolio composition too often. As for the second concept, according to Benartzi and Thaler (1985), investors that are constantly checking the results of their investment tend to behave like their investment horizon were short as well, even if they have long-term horizons. The authors point out that, given that investors' preferences are usually dictated by the perspective theory (Kahneman and Tversky, 1979) and given the American market's risk premium, investors usually check upon their investment once a year. There is no literature on the subject in Brazil. Fraga (2007) says that the frequency with which statements are sent out is directly linked to the investors' decision to redeem the investment.

How often returns happen in a year is also important to pension funds. Members and sponsors of plans managed by pension funds are clients with long-term horizon investments. However, constant returns throughout the year are important due to their effect in sponsors' balance sheets. Besides, in Brazilian pension fund market, there are legal provisions regarding contribution raises or benefit reductions that must be implemented in case the investment value is more than 10% less than actuarial liability at the end of the year for two consecutive years.

Thus, managers have been forced to pay more attention to short-term in their investment decisions, which makes it much more complicated. Correctly predicting market movements is not a trivial task, especially for short periods. Despite improvements in statistical techniques and finance, there is still great difficulty in adopting optimized investment allocation models with market risk control. An estimated optimized risk and return solution seldom occurs short-term and it is always liable to changes in parameters during the investment period.

The purpose of this essay is to verify if dynamic reallocations amongst main Brazilian asset classes can create gains in a long period and limit losses in shorter periods. The methodology is based on work by Herold et al. (2007). Asset class allocation is done dynamically and comes from maximum risk – calculated using sum at risk (VaR), as a result of the loss limit defined for a short-term horizon. Only a few studies have been exploring this topic and, yet, for specific purposes. Meanwhile, alternative strategies have been tested based on keeping a static allocation throughout the short-term horizon and on put option acquisition. The obtained results were compared with the return on risk-based dynamic allocation strategy. The development of investment management tools is extremely important to solve this apparent paradox. Without elevating risk exposure, it is not possible to seek higher return. However, increasing risk in the portfolio elevates the chance of getting negative returns. The solution to solve this dilemma is to build portfolios that can absorb asset appreciation and, at the same time, limit short-term losses.

Results show that a dynamic strategy has been proven capable of resulting in short-term gains when risk assets were relatively run off. On the other hand, its use in surge markets was not appropriate, as continuous position elevations extended the loss limit. Where Ibovespa was the only risk asset, test returns were close to those in Herold et al (2007), with losses limited in short term and positive returns compatible with benchmark in long term.

This essay is organized as follows: Chapter 2 presents the literature review; Chapter 3 describes sample attributes and work methodology; the subsequent results are presented and analyzed in Chapter 4; and Chapter 5 is the conclusion.

LITERATURE REVIEW

The used methodology is based on the work by Herold et al. (2007). The authors simulated, in the German market, the application of portfolio dynamic allocation model composed of two or more asset classes that do not need asset return forecast. The purpose of the model is to conciliate positive performance for mixed horizon portfolios, based on the concept of strategy risk minimization. Results show that the use of sum at risk techniques allows long-term returns close to benchmarks and limit losses in shorter periods.

Dierkes, Erner and Zeisberger (2009) also analyzed strategies to protect capital allocation in securities, bonds and options. The premise of this work is that the investor behaves much like the description in the Perspective Theory. The study shows that the

strategy depends largely on the investment horizon. For short and mid-term horizons, the portfolio protection strategies show positive results, whereas for longer periods, investment in securities without protection has the best results.

Chonghui, Yongkai and Yunbi (2009) define investment composition in two asset classes, risk and no risk, based on the maximum risk strategy arising from sum at risk. Results suggest that these portfolios limit losses the Chinese stock market, but they clearly limit gains during surges. Jianga, Maa and Na (2009) have performed the same test in the Chinese market, with stock market index, fixed-income index and no risk asset. Results indicate that strategies based on VaR minimize losses when markets are trading down and still show good results during surges.

Dichtl and Drobetz (2011) evaluate portfolio protection strategies using Monte Carlo simulation applied to German market, to allocate capital in securities, fixed-income and mixed portfolios. The authors concluded that protection strategies present more valuable results to investors that make decisions based on the Perspective Theory, as losses are minimized when the market is trading down.

In Brazil, Andrade (2006) compares the performance of asset allocation strategies according to two different approaches: the traditional average-variance approach and the asymmetrical risk approach. The second methodology showed better results.

SAMPLE AND METHODOLOGY

DATABASE DESCRIPTION

As to asset allocation, securities and fixed-income bonds are the most used investment classes in Brazil. From these two, most is invested in fixed-income bonds.[1]

Based on these resource distribution attributes, the first benchmark is Ibovespa, which really represents those securities with more volume of negotiation and presents extensive data. As fixed-income government bonds were only benchmarked in 2005, two separate studies were conducted to apply risk-based dynamic total return strategy. This helped to prevent that diminished data availability for this second benchmark could impair the results.

In the first part of the study, a variable income asset was considered, represented by Ibovespa, and a fixed-income asset, with daily Selic rate return, between 1991 and 2007[2].

[1] Please refer to ANBID's Daily Analysis on the Investment Fund Industry (2008) and Statistics Consolidation (2008) in Fundos de Pensão (Pension Funds) magazine.

AS the considered investment horizon is one year, the method application was assessed 17 times. The yield on unused resources to acquire securities under Selic depends on being fully invested in daily committed operations.

Ibovespa's closing quotes were obtained through Economatica database, and Selic daily rates were obtained on Brazilian Central Bank's database. From Selic daily rates, an index number was created in order to reflect accumulated monetary variations arising from an investment with return on such rate. On 12/12/1989, the index was created, just for reference, as 100. Being IS_t the Selic index on day t from 13/12/1989 to 30/12/2007 and TS_t the daily Selic rate, as published by the Brazilian Central Bank, then:

$$IS_t = IS_{t-1} \times (TS_{t-1}/100 + 1) \quad (1)$$

In the second part of the study, three assets were used: a fixed-income asset with return on Selic rate, a variable-income asset represented by Ibovespa and an inflation-linked asset, represented by IMA-B.[3] The period from 26/12/2003 to 30/06/2004 was used to project volatilities and correlations to be used in allocating each asset from the semester beginning on 01/07/2004. The method application results were verified in eight periods: from the second half of 2004 to the first half of 2008. Thus, the risk-based dynamic allocation strategy was assessed with the possibility of allocating resources in the main risk asset classes adopted by investment funds and, in case of inflation-linked asset, by pension funds. In order to increase the result assessment periods, the short-term investment horizon was established as one semester.

FORMALIZING THE EVALUATED STRATEGY

The starting point of the risk-based dynamic allocation strategy is the definition of a risk budget for a short-term investment. The risk budget is the maximum loss suffered by the portfolio in a short-term investment horizon. That is, the offset between the portfolio value at the beginning of the investment horizon and the budget risk is the lowest value allowed for the portfolio at end of the period. Given that C_t is the value of portfolio C at the moment t, $0 \le t \le T$, where 0 is the beginning, T is the end of the investment horizon

[2] Data from 1990 was not used in the test because, in that year, Plano Collor altered market patterns, especially the financial market, and established huge restrictions to free resource allocation. Until 1990, the securities market business was usually carried out in Rio de Janeiro's Stock Market, so Ibovespa was not the benchmark for variable income in Brazil.

[3] IMA-B is the benchmark for inflation-linked government bonds. The IMA-B, created in September 2003, was chosen because of its similarities to NTN-B, in their composition, with actuarial liability from pension plans. The availability of long-term due dates and link to IPCA make NTN-B the best place to allocate pension fund resources.

and L is the risk budget or loss limit previously defined for such investment horizon, comes the following restriction:

$$C_T \geq (C_0 - L) \tag{2}$$

In a portfolio composed of several risk assets, the determination of the estimated portfolio value at the end of the period during the investment horizon is stochastic. Therefore, it depends on the use of a probabilistic model and choosing a confidence level. If $VaR_{t,T}$ is the maximum loss calculated at t for the end of horizon T, given a level of confidence (1-α); and that C^*_T is the lowest portfolio value projected at t for the end of horizon T, given a confidence level (1-α); then:

$$C^*_T = C_t - VaR_{t,T} \tag{3}$$

In a normal return scenario, VaR would be:

$$VaR_{t,T} = -W_0(R^* - \mu) = W_0 \alpha \sigma \sqrt{\Delta t} \tag{4}$$

Where W_0 is the initial investment; R* is the critical return; (1-α) is the confidence level; σ is volatility; Δt is the time window (horizon); and μ, expected return.

The risk budget tells the difference between the portfolio market value and its least tolerated value dynamically indicates the maximum loss such portfolio can be exposed to. Otherwise, (2) and (3) implies:

$$VaR_{t,T} \leq C_t - (C_0 - L) \tag{5}$$

The risk assets are those that can offer the portfolio a return above the free risk rate; therefore, the risk-based dynamic allocation strategy sets that the allocation in this asset category should be the one that dynamically exposes the portfolio to its maximum VaR, conditioned to the limitation imposed by the risk budget. At each moment t, allocation in risk asset must be in a way that, for the predefined confidence level (1-α):

$$VaR_{t,T} = C_t - (C_0 - L) \tag{6}$$

If the allocation is made in a risk free asset with a deterministic return, and in risk assets with log-normal return, two parameters must be projected to determine the $VaR_{t,T}$: average and standard deviation, or volatility, of the risk asset return logarithm.

PARAMETERS AND CONVENTIONS USED FOR THE TEST

In Brasil, the daily Selic rate used as benchmark for risk free asset allocation returns has varied hugely during the backtest of the dynamic allocation strategy. In order to enable a single risk limit to all annual risk budgets, all risk asset series were divided by the Selic index. That is:

$$IB_t = \frac{Ibovespa_t}{IS_t} \tag{7}$$

$$IM^t = \frac{IMA_t}{IS_t} \tag{8}$$

IB and *IM* and index for a risk asset found in the index of a risk free asset. As a consequence, *IB* and *IM* are Ibovespa and IMA returns, benchmarks for market risk assets, deducted from risk free asset returns for the same period. The deflator of the series representing risk assets, *IS* , indicates daily appreciation, equivalent to Selic's return.[4] Due to *IS* definition, the return on the risk free asset is zero when deflated by *IS* .

The values expected fro IB_t and IM_t return logarithms were considered zero for all backtest investment horizons. The backtest standard deviation that considered only Ibovespa as a risk asset was projected based on 252 observations with a decay factor of $\lambda = 0{,}94$ [5], using the Exponentially Weighted Moving Average (EWMA) method. In the study involving allocation in risk classes in Ibovespa and IMA, the standard deviation for both series, as well as covariance, was also projected from $\lambda = 0{,}94$ and 126 observations. If rI_t is the logarithmic return at t for IB_t and IM_t; hI_t the standard deviation for rI_t projected in t ; and $hIBIM_t$ the covariance between rIB_t and rIM_t projected in t ; then:

$$hI_t = \sqrt{\lambda hI_{t-1}^2 + (1-\lambda) rI_{t-1}^2} \tag{9}$$

$$hIBIM_t = \lambda(hIBIM_{t-1}) + (1-\lambda) rIB_t rIM_t \tag{10}$$

In order to carry out the backtest with two risk assets, an additional function had to be added, as the function that defines allocation based on the highest projected VaR within

[4] It is important to point out that, in case the series were not transformed, it would be necessary to establish a risk limit for each year and, further on, to define criteria for such choice. Due to its construction, the risk-based dynamic allocation would elevate risk asset allocation in years with a high free risk rate. It occurs because, as time goes by, the return on the risk free asset opens up a spot in the risk budget. Given that, in most economies, a free risk rate usually does not have relevant return, we chose to deflate the series using the Selic index, in a way that the high return rates for risk free assets used in Brazil would not interfere in the results of the allocation strategy tests.

[5] As used by Riskmetrics (1996).

the risk budget refers only to allocation between the risk asset, which is a composition of all market risk classes, and risk free asset. The allocation between two risk assets depends on an additional criterion. In order to preserve the strategy's dynamic and cyclic attributes, the allocation between those risk assets was made in proportion as needed to fake a rainbow option, payoff being the asset with highest return at the end of the investment horizon. If $\rho_{IBIM,t}$ is the correlation coefficient between IB and IM projected in t; $d_{1,t}$ the IB ration in the risk asset; $(1-d_{1,t})$ the IM installment in the risk asset; using Stulz (1982) model to price option on maximum or minimum for two risk assets, then:

$$d_{1,t} = \frac{\ln\left(\frac{IB_t IM_0}{IM_t IB_0}\right) + \frac{1}{2}\sigma_t^2 (T-t)}{\sigma_t \sqrt{(T-t)}} \quad (11)$$

$$\sigma_t^2 = hIB_t^2 - 2hIB_t\, hIM_t\, \rho_{IBIM,t} + hIM_t^2 \quad (12)$$

From the composition defined by $d_{1,t}$, the calculated $VaR_{t,T}$ according to the Formula 3, the composition between risk and free risk assets is determined.

BACKTEST

In the backtest, the return, calculated using risk-based dynamic strategy and other alternative strategies, were analyzed according to the following criteria:

i) The strategy's efficiency in limiting portfolio run-off up to risk budget standards;

ii) Strategy's upsides and downsides to avoid losses and absorb short-term gains;

iii) Long-term return comprising the 17 years used in the test.

COMPARABLE STRATEGIES

Two other strategies were used as comparison to the dynamic allocation strategy: fixed allocation during the whole short-term investment and allocation protection in risk asset through acquisition of equivalent put option amount.

In fixed allocation, the initial allocation defined by the dynamic strategy was considered for the whole year. Reallocation in the following year depended on the risk budget, the chosen confidence level and projected volatility. Regarding the protection through acquisition of put option along with allocation in variable income, this option is used to limit annual losses of a portfolio with a defined risk budget.

Using the entire risk limit to acquire put options and conditioning the Ibovespa allocation to the position in put options, it is possible to obtain the allocation in the risk asset. To calculate the option price, the Black & Scholes (1973) model was used. Ibovespa volatility used was obtained using the EWMA method based on 252 days and $\lambda = 0.94$, which is the same projection used to calculate risk-based dynamic allocation.

RESULTS

The results of portfolio strategies with Selic-linked asset and Ibovespa, and portfolio comprising Selic-linked asset, variable-income asset and inflation-linked fixed-income asset are described below.

BACKTEST - RISK-BASED DYNAMIC ALLOCATION STRATEGY WITH *IB* AND *IS*

In order to understand the effects of the parameters used for the risk-based total return strategy on the portfolio's short and long-term return, several simulations were made in different levels each parameter, besides comparison to alternative strategies.

DYNAMIC STRATEGY'S SENSITIVITY TO RISK BUDGET

The first parameter checked was loss limit or risk budget. Table 1 presents annual returns, total return and average for the 17 years used in the backtest, and the lowest return in the period for different levels of risk budget. The confidence level (1-α) was kept 95% for all loss limit levels and the transaction cost was not considered. The voluntary allocation in variable income was limited to 100%; short-selling was not allowed.

TABLE 1: RETURN – DYNAMIC ALLOCATION STRATEGY WITH RISK BUDGET

	Annual Loss Limit									
Year	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1991	10.02%	16.71%	22.20%	26.23%	30.72%	47.19%	65.73%	82.78%	94.57%	104.42%
1992	-0.71%	-1.42%	-2.13%	-2.84%	-3.54%	-4.24%	-4.93%	-5.63%	-6.32%	-7.01%
1993	0.54%	1.03%	1.45%	1.82%	2.30%	2.79%	3.22%	3.48%	3.70%	3.89%
1994	-0.89%	-1.77%	-2.66%	-3.53%	-4.41%	-5.28%	-6.15%	-7.02%	-7.88%	-8.75%
1995	-0.76%	-1.51%	-2.26%	-3.01%	-3.76%	-4.50%	-5.23%	-5.96%	-6.69%	-7.42%
1996	1.17%	2.22%	3.07%	3.68%	4.27%	4.88%	6.05%	7.03%	7.67%	8.11%
1997	-1.11%	-2.20%	-3.28%	-4.34%	-5.40%	-6.45%	-8.70%	-9.43%	-9.01%	-10.01%
1998	-1.00%	-1.99%	-2.99%	-3.98%	-4.97%	-5.97%	-6.96%	-7.95%	-8.94%	-9.93%
1999	8.87%	16.55%	22.60%	28.14%	32.93%	36.85%	40.79%	44.24%	47.28%	50.02%
2000	-0.85%	-1.70%	-2.54%	-3.37%	-4.20%	-5.03%	-5.85%	-6.66%	-7.47%	-8.28%
2001	-0.85%	-1.70%	-2.54%	-3.37%	-4.20%	-5.02%	-5.84%	-6.65%	-7.45%	-8.25%
2002	-0.75%	-1.50%	-2.24%	-2.98%	-3.71%	-4.44%	-5.16%	-5.88%	-6.59%	-7.30%
2003	9.45%	16.05%	20.35%	23.42%	26.08%	28.18%	30.07%	31.71%	33.61%	35.93%

2004	0.26%	0.51%	0.75%	0.96%	1.15%	1.29%	1.33%	1.42%	1.54%	1.72%
2005	0.67%	1.33%	1.99%	2.65%	3.31%	3.97%	4.63%	5.28%	5.93%	6.59%
2006	1.68%	3.16%	3.71%	4.43%	4.95%	5.39%	5.90%	7.22%	7.69%	7.91%
2007	-0.69%	-1.39%	-2.10%	-2.81%	-3.50%	-0.08%	5.33%	7.69%	9.10%	9.87%
Total	26.76%	46.94%	59.60%	67.68%	74.37%	102.74%	137.25%	167.52%	188.32%	198.97%
Averages	1.40%	2.29%	2.79%	3.09%	3.32%	4.25%	5.21%	5.96%	6.43%	6.65%
Minimum Return	-1.11%	-2.20%	-3.28%	-4.34%	-5.40%	-6.45%	-8.70%	-9.43%	-9.01%	-10.01%

The results refer to the potfolio's strategy with asset linked to Selic and Ibovespa for the period between 1991 and 2007. The confidence level is 95%, and the transaction cost was disregarded. Voluntary allocation in variable income was limited to 100%; no short-selling was allowed.

The risk-based dynamic allocation average return increased with the established loss limit. Except for 1997, whenever the return was negative, the defined loss limit was not exceeded. The Brazilian financial market in 1997 was influenced by internal and external factors that altered asset prices. After a stock market surge in 1996 due to the stabilization of the Brazilian economy with Plano Real and the ongoing privatization program, 1997 began with expectancy on Brazilian securities. In April that year, the congress enacted the possibility of reelecting the President of the Republic, along with other Executive members. Vale do Rio Doce was privatized on May 6th, 1997, which reinforced Ibovespa expectancy, once Telebras, whose shares comprised most of the index at the time, would be the next privatized company. From July on, however, a crisis broke out in Southeast Asia, where, at the time, was the international capital's favorite destination.

The dynamic strategy entered 1997 with only 15.3% of its portfolio in variable income. There was more exposure due to the extension of the risk limit by appreciation of the original allocation. In the first half of July, at the same time Ibovespa reached the year's maximum quote, the dynamic strategy's variable income allocation was elevated for all risk limits. For all risk budgets between 5% and 10% of loss limit, the allocation in variable income reached 100% in the strategy simulation.

The Asian crisis caused Ibovespa to drop from August onwards. The increase in volatility in this period was not enough to materially reduce allocation in assets, once the loss limit formed by the initial risk budget plus gains up to that moment largely offset the small risk elevation suffered by the market at the time.

The general feeling was that Brazil's economic and political agenda would save the country from the Asian crisis; its extension was not clear at the time. In October 23rd, however, the Hong Kong Stock Market had a major drop, which contaminated the markets around the world. By the end of October, Ibovespa ran off 30%. The massive drop on

October 27th was heavier than the protective "cushion" formed by the risk budget plus appreciation. The variable income allocation was, then, zeroed and so it was kept until the end of the year, which prevented the strategy from absorbing part of the Ibovespa appreciation occurred in November and December.

The second biggest losses to each of the risk budgets were close to the defined threshold. In general, the strategy observed the risk budget regarding all loss limits defined in the simulations. This result is compatible with the work by Herold et al (2007).

DYNAMIC STRATEGY'S SENSITIVITY TO THE CONFIDENCE LEVEL

The second parameter was the confidence level, (1-α), chosen to calculate the portfolio's VaR. Using a 5% loss limit, the return on risk-based dynamic allocation strategy was calculated for (1-α)= 99%, 97.5%, 95%, e 90%. Table 2 indicates, as expected, that the strategy applied with higher confidence levels have more return, as opposed to higher risks involved.

TABLE 2: DYNAMIC STRATEGY RETURN PER CONFIDENCE LEVEL.

	Confidence Level			
Year	99%	97,5%	95%	90%
1991	30.03%	29.90%	30.72%	68.50%
1992	-2.65%	-3.07%	-3.54%	-4.19%
1993	3.19%	2.82%	2.30%	0.93%
1994	-3.55%	-4.00%	-4.41%	-4.82%
1995	-3.14%	-3.43%	-3.76%	-4.21%
1996	3.96%	4.14%	4.27%	4.78%
1997	-4.98%	-5.22%	-5.40%	-7.52%
1998	-4.82%	-4.92%	-4.97%	-5.00%
1999	24.41%	28.55%	32.93%	37.97%
2000	-3.37%	-3.79%	-4.20%	-4.68%
2001	-3.34%	-3.77%	-4.20%	-4.68%
2002	-2.92%	-3.30%	-3.71%	-4.28%
2003	21.49%	23.91%	26.08%	28.67%
2004	1.59%	1.47%	1.15%	0.24%
2005	2.58%	2.94%	3.31%	3.75%
2006	4.99%	5.10%	4.95%	4.30%
2007	-0.98%	-2.24%	-3.50%	-4.78%
Total	70.36%	72.37%	74.37%	118.11%
Average	3.18%	3.25%	3.32%	4.69%
Minimum Return	-4.98%	-5.22%	-5.40%	-7.52%

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, and the defined lost limit is 5%. The transaction cost was disregarded.

In 1991, 1999 and 2003, when the stock market was greatly and continuously up, the use of lower confidence levels allowed the strategy to absorb more gains than it would had it used higher confidence levels. When Ibovespa was down, higher confidence levels

cushioned losses. Under 99% confidence, even losses suffered in 1997 did not cross the loss limit. Very low confidence limits in the strategy higher loss risks than those created by the risk budget, like what happened in 1997, with a 90% confidence level.

DYNAMIC ALLOCATION VS. STATIC ALLOCATION

To verify the importance of the dynamic adjustment in risk-based allocation strategy, the return was compared with those from constant allocation each year. The annual loss limit was set at 5% and the confidence level, 95%. Table 3 shows initial allocations for the risk-based strategy, every year, according to defined parameters. In the column "Return without dynamic adjustment", the return is shown as if the initial allocation was maintained throughout the year. Return arising from dynamic strategy is in the subsequent column.

TABLE 3: ALLOCATION RETURN WITH AND WITHOUT DYNAMIC ADJUSTMENT

Year	Initial Allocation Variable Income	Return without Dynamic adjustment	Return with Dynamic adjustment
1991	6.75%	18.88%	30.72%
1992	6.24%	-2.02%	-3.54%
1993	6.55%	5.04%	2.30%
1994	7.07%	-0.72%	-4.41%
1995	8.25%	-2.93%	-3.76%
1996	6.85%	1.95%	4.27%
1997	12.68%	2.05%	-5.40%
1998	17.06%	-8.25%	-4.97%
1999	10.47%	10.52%	32.93%
2000	6.35%	-1.52%	-4.20%
2001	10.76%	2.11%	-4.20%
2002	11.02%	-3.34%	-3.71%
2003	13.43%	8.04%	26.08%
2004	13.44%	0.18%	1.15%
2005	12.05%	0.88%	3.31%
2006	15.17%	-1.72%	4.95%
2007	18.21%	5.17%	-3.50%
Total		36.43%	74.37%
Average	10.73%	1.84%	3.32%
Minimum Return		-8.25%	-5.40%

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, and the defined lost limit is 5%. The transaction cost was disregarded.

Nine out of 17 simulations, the return on dynamic strategy was lower than on static allocation. However, dynamic allocation's total return was far more superior than static

allocation's. Best dynamic allocation return was observed in years the market was trading too up or down.

In case of downside years, increase in volatility and losses incurred by the portfolio consumed the risk budget. Therefore, the dynamic strategy reduced the allocation in the risk asset, even allocating all portfolio resources in the free risk asset.

In those years when Ibovespa was up, the dynamic strategy elevated variable income allocation according to the initial appreciation and volatility reduction of this index, which generated more gains compared to the static position. The dynamic strategy had best results in 1991, 1999 and 2003. Those three periods started under the influence of preceding years when strong depreciation happened in the stock market due to economic or political events. As time and the way those events could reflect on the assets were unknown, the upside in 1991, 1999 and 2003 could not be forecast.

In the beginning of 1990, President Fernando Collor de Melo had just taken office and, with a view to stop the inflation process that was undermining the country, gave a liquidity shock in the economy, blocking most money assets belonging to the private sector. The effects were a major downside and production disorganization, income and job reduction, as well as a huge depreciation of assets. The economy's monetization began mid-1990, in a segmented and disorganized way. The bridges across several economic segments, however, spread monetization to all sectors. At the end of that year, inflation reared its head and, as the population feared that the assets could be blocked again, an unexpected surge for securities took place the following year, especially stock.

In 1998, the international crisis that broke out a year before in Southeast Asia deepens and hits Russia. Countries in deficit regarding current transactions were the most vulnerable to the crisis, due to a lack of available foreign capital. Those countries that used to adopt a fixed exchange were forced to devalue their currency, and some of them altered their exchange policy to a floating exchange rate, as all foreign accounts were blocked. As of the second half of 1998, Brazil's balance of payment conditions worsened, so the Brazilian Central Bank decided to increase the economy's interest rate in order to attract foreign capital, reduce the balance of trade deficit, thus preventing a collapse caused by the fixed exchange rate policy. In January 1999, the situation of Brazil's foreign accounts was unbearable due to the derisive level of international reserves, despite several loans taken from multilateral organisms the year before. After trying to make a controlled depreciation of Real, the Brazilian Central Bank adopted a floating exchange rate. Also in January 1999, Real's depreciation regarding the US Dollar reached 65.2%.

Real's depreciation caused Brazilian stock to drop compared to US Dollars, and such quotes had been already much depreciated the year before. Upon adoption of the floating exchange rate, the basic interest rate could be reduced and, given the increased competition amongst tradable companies, there was an increase in demand for Brazil's stock, which caused a surge in Ibovespa in 1999.

2003 was a year entailing many other bad years for the Brazilian economy. Upon improvement of macroeconomic conditions arising from the adoption of the floating exchange rate and Balance of Payment conditions, Brazil suffered a major lack of energy, with prices skyrocketing, harming GDP. Amidst all that, the perspective of a left-wing President taking office caused many foreign investors to flee and knocked down the Real. Inflation started to rise, so the interest rate was raised.

In the beginning of 2003, the forecast of the Brazilian economy was not good, but, after the downsides in 2000, 2001 and 2002, they were already quite reflected on stock prices. Throughout 2003, the new government managed to gain the investors' trust again by keeping the floating exchange rate and conducting rigid monetary and fiscal. Foreign capital started to invest in Brazilian assets little by little and, throughout the year, investors elevated their allocation in variable income. In spite of the forecast at the beginning of the year, 2003 ended with a strong Ibovespa appreciation.

A relevant point to be observed regarding return on dynamic strategies as opposed to static allocation is transaction cost. Appreciation of the relevant dynamic strategy to be used in the comparison must be net of transaction costs, so no return that could not actually be gained is computed. Return coming from dynamic and static simulations, considering transaction costs, is shown in Table 4. Brokerage and fee costs incurred by big variable income clients in Brazil are approximately 11 basis points on the negotiated value. In order to ensure quick positioning of reallocations defined by the dynamic strategy, an assumption was made that every reallocation is done in two tranches. Initially, reallocation is done using futures contracts and, later, this position is undone simultaneously positioning in free float stock. Thus, investment reallocation needed three operations that demanded 33 basis points to be paid for transaction cost purposes.

As in static allocation the portfolio repositioning happens only at the beginning of each year, only on those dates the transaction costs calculated on reallocated values were reduced. In the dynamic strategy, at each reallocation, the transaction costs are deducted from the reallocated portion. The results of both the risk-based dynamic allocation strategy,

net of brokerage, with 5% loss limit and confidence level of 95% and the static allocation throughout the year are presented in Table 4.

TABLE 4: RETURN NET OF TRANSACTION COST WITH AND WITHOUT DYNAMIC ADJUSTMENT.

Year	Initial Allocation Variable Income	Return without Dynamic adjustment	Return with Dynamic adjustment
1991	6.75%	18.88%	25.73%
1992	6.24%	-2.08%	-3.72%
1993	6.55%	5.03%	1.06%
1994	7.07%	-0.73%	-4.54%
1995	8.25%	-2.94%	-3.91%
1996	6.85%	1.94%	2.81%
1997	12.68%	2.04%	-5.36%
1998	17.06%	-8.26%	-5.01%
1999	10.47%	10.51%	29.74%
2000	6.35%	-1.57%	-4.44%
2001	10.76%	2.09%	-4.46%
2002	11.02%	-3.35%	-4.05%
2003	13.43%	8.03%	23.57%
2004	13.44%	0.16%	-0.59%
2005	12.05%	0.87%	2.42%
2006	15.17%	-1.73%	2.92%
2007	18.21%	5.16%	-4.27%
Total		36.08%	46.11%
Average	10.73%	1.83%	2.26%
Minimum Return		-8.26%	-5.36%

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, and the defined lost limit is 5%. The transaction cost was taken into consideration.

In both cases, the simulations did not consider transaction costs of initial allocation in the risk asset, but it bears no effect on comparison, as both strategies cost the same thing. The transaction costs reduced the return on the risk-based dynamic allocation strategy; the static allocation, on the other hand, was not affected, because it is adjusted only once a year.

1997 had unexpected results, when return on dynamic strategy, net of transaction costs, was higher than return without considering such costs. This happened because reduction on the portfolio's total value due to brokerage throughout the year consumed a portion of the risk budget. When Ibovespa started trading down as of October, the portfolio's value was lower upon discount of brokerage than when those costs were disregarded, which caused less allocation in risk asset at the downside and, thus, fewer losses.

DYNAMIC ALLOCATION X PUT OPTION ACQUISITION

Table 5 presents the annual volatility used to calculate the put option, price, resulting allocation in Ibovespa and return on the use of put options as insurance and dynamic strategy. In both cases, a 5% loss limit was used as risk budget and 33 basis points were used as transaction cost. The brokerage on the first allocation of both strategies was disregarded, as well as transaction costs regarding put options.

TABLE 5: RETURN ON ALLOCATION BASED ON PUT OPTIONS AND RISK-BASED DYNAMIC ALLOCATION STRATEGY.

Year	Volatility year used to calculate put option	Put option premium	Allocation in Variable Income secured by put option	Return on strategy with put option	Return with Dynamic Adjustment
1991	82.06%	31.84	15.70%	38.91%	25.57%
1992	98.28%	37.69	13.27%	-5.12%	-3.96%
1993	87.58%	33.85	14.77%	6.34%	1.96%
1994	74.68%	29.11	17.17%	-5.01%	-4.61%
1995	56.66%	22.31	22.42%	-5.03%	-4.13%
1996	79.63%	30.95	16.16%	-0.42%	3.00%
1997	30.49%	12.12	41.26%	2.22%	-5.40%
1998	21.08%	8.40	59.55%	-5.06%	-4.85%
1999	39.49%	15.65	31.94%	27.01%	32.55%
2000	94.20%	36.24	13.80%	-5.14%	-4.24%
2001	37.99%	15.07	33.19%	-5.08%	-4.11%
2002	36.78%	14.59	34.27%	-5.01%	-4.51%
2003	28.31%	11.26	44.41%	21.56%	23.93%
2004	28.28%	11.25	44.46%	-3.95%	1.32%
2005	32.61%	12.95	38.61%	-2.54%	4.30%
2006	24.30%	9.67	51.69%	3.55%	3.77%
2007	19.51%	7.77	64.34%	13.90%	-4.79%
Total				78.14%	56.78%
Average				3.45%	2.68%
Minimum Return				-5.14%	-5.40%

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, and the defined lost limit is 5%. The transaction cost was taken into consideration.

Besides not exceeding the risk limit[6], the allocation in the risk asset, along with the position in put options, had a higher return in the test period than the risk-based dynamic strategy. As the dynamic strategy is more flexible in terms of increasing allocation in risk asset, the return was better in years when Ibovespa had a continuous surge. The put option

[6] Return slightly under 5% occurred due to brokerage costs of Ibovespa allocation at the beginning of each year.

strategy had best return in years when, after a fist surge, Ibovespa dropped abruptly, as in 1991, 1993, 1997 and 2007. When this abrupt drop happened, the dynamic strategy was strongly allocated in risk asset and was forced to reduce allocation in Ibovespa for lower prices than those in recent acquisitions.

Each of these years had an unexpected event that caused a strong downside, just after Ibovespa had undergone a major surge. The drop in the second half of 1991 was justified by the corruption allegations against the President of the Republic at the time. As it was a unique and unexpected situation, there is no consensus over the outcome and consequences that those allegations could have on asset prices. At the end of 1991, the general feeling was that there would not be further consequences, so Ibovespa was up. The dynamic strategy, which had reduced risk exposure before, could not fully absorb the Ibovespa surge at the end of the year.

In October 1993, a Congressional Investigation Committee (CPI) was set up in order to assess those corruption allegations made by members of the Congress' Budget Committee; that created havoc in the financial market. The surge observed at the time was caused by the privatization of the Companhia Siderúrgica Nacional (CSN) in the first semester and by an economic plan that was being considered coherent and feasible by the financial market, with a view to stop the chronic inflation of the last twenty years. The institutional crisis caused by the CPI awoke insecurities as to the political frame needed to carry on the economic plan, as many legal amendments would be needed to fully implement it. Again, the dynamic strategy was deeply allocated in risk asset because of the downside near the end of the investment horizon in 1993.

In the year of 1997, the aforementioned Southeast Asia crisis was the root of an unexpected reversion of the market surge. But in 2007, after a surge in the first half, Ibovespa dropped, following the depreciation in all major stock markets in the world, as a reflection of the first symptoms of the subprime crisis. In the final months of 1997, however, Ibovespa went back up again, pressed by the surge in commodities in the international market, which helped many companies that were really present in this index. The dynamic strategy also suffered losses in this year because it was greatly exposed in variable income at the time of the downside, and reduced Ibovespa allocation, but could not fully absorb the gains at the end of the year.

Although the put option alternative to absorb gains in a surge market, limiting possible annual losses to a certain value, had better results in the simulation, it is important to point out that the put option market in Brazil is really restricted. Normally, put option

transactions, especially those due over two months, are only carried out in OTC market. The actual transaction cost depends, therefore, on the spread by the available counterparties. Moreover, in case there is no secured type clearing registration, there will be a counterparty risk that needs to be assessed before a decision is made.

NEGOTIATION PARAMETER INCORPORATION IN DYNAMIC ALLOCATION

As the risk-based dynamic strategy allocation is calculated based on a continuous distribution, reallocations between risk asset and risk free asset are made on a daily basis. In order to reduce the elevated churn in the dynamic allocation strategy, return was calculated for many negotiation levels. The strategy daily reallocation was only conditioned to a minimum negotiation level, defined as a percentage on the portfolio's full value. Thus, it was possible to reduce the churn, represented by the annual sum of the ratio of business performed compared to the portfolio's value. In the calculations summed up in Table 6, a 5% risk budget, 95% confidence level and 33 basis points transaction cost were used. It sums up the annual turnover and return on the portfolio, besides the return/turnover ratio calculated for the whole period and each negotiation level.

TABLE 6: TURNOVER AND RETURN ON DYNAMIC ALLOCATION STRATEGY PER NEGOTIATION LEVEL.

	Negotiation.= 0		Negotiation .= 1%		Negotiation .= 2%		Negotiation .= 3%		Negotiation .= 4%		Negotiation .= 5%	
Date	Return	Turnover	Return	Turnover	Return	Turnover	Return	Turnover	Return	Turnover	Return	Turnover
1991	25.73%	930.9%	25.36%	890.1%	23.83%	795.7%	23.52%	777.4%	25.40%	781.0%	25.57%	736.5%
1992	-3.72%	95.8%	-3.61%	61.0%	-3.36%	44.9%	-3.79%	38.1%	-4.09%	31.0%	-3.96%	25.6%
1993	1.06%	379.8%	1.15%	348.6%	2.14%	330.5%	1.38%	302.2%	1.94%	299.7%	1.96%	270.7%
1994	-4.54%	150.5%	-4.55%	103.5%	-4.36%	77.3%	-4.27%	55.0%	-4.59%	26.1%	-4.61%	31.6%
1995	-3.91%	76.9%	-3.74%	53.5%	-3.72%	45.0%	-4.34%	14.5%	-3.82%	27.9%	-4.13%	25.3%
1996	2.81%	406.2%	2.87%	374.1%	3.06%	323.6%	3.13%	282.2%	3.39%	279.9%	3.00%	277.1%
1997	-5.36%	759.9%	-5.37%	744.7%	-5.37%	699.4%	-5.38%	664.7%	-5.38%	659.2%	-5.40%	598.1%
1998	-5.01%	99.6%	-4.99%	57.9%	-5.00%	42.8%	-5.00%	37.1%	-4.75%	33.5%	-4.85%	26.4%
1999	29.74%	384.7%	28.69%	343.7%	31.32%	320.2%	33.28%	292.4%	32.82%	267.3%	32.55%	219.2%
2000	-4.44%	152.9%	-4.45%	108.5%	-4.26%	87.9%	-4.23%	77.2%	-4.45%	47.6%	-4.24%	51.2%
2001	-4.46%	139.8%	-4.38%	102.2%	-4.49%	77.6%	-4.65%	53.6%	-4.45%	61.2%	-4.11%	98.6%
2002	-4.05%	134.4%	-3.96%	103.2%	-3.89%	91.1%	-4.45%	44.1%	-4.01%	71.1%	-4.51%	36.0%
2003	23.57%	347.3%	25.06%	274.0%	24.66%	248.9%	26.28%	216.3%	24.55%	235.2%	23.93%	247.5%

2004	-0.59%	374.2%	-0.36%	315.2%	0.12%	281.8%	0.54%	257.7%	0.65%	223.6%	1.32%	224.2%
2005	2.42%	501.1%	2.79%	456.1%	3.28%	406.8%	3.19%	364.4%	3.34%	358.7%	4.30%	355.0%
2006	2.92%	438.2%	3.27%	394.1%	3.34%	361.1%	3.80%	329.6%	3.18%	327.0%	3.77%	317.3%
2007	-4.27%	767.9%	-4.27%	746.8%	-4.29%	703.8%	-4.26%	722.6%	-4.24%	706.2%	-4.79%	646.5%
Total Return	46.11%		48.50%		53.4%		54.88%		56.20%		56.78%	
Average Return	2.26%		2.35%		2.55%		2.61%		2.66%		2.68%	
Average Turnover		361.2%		322.2%		290.5%		266.4%		261.0%		246.3%
Return/Turnover		0.128		0.151		0.184		0.206		0.215		0.231

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, and the defined lost limit is 5%. The transaction cost was taken into consideration.

It is possible to notice the reduction on brokerage payments due to turnover reduction caused by the adoption of a minimum limit to reallocate assets.

DYNAMIC ALLOCATION UNDER BRAZILIAN PENSION FUND RULES

To broaden the scope of this study, the legal limits to allocate investment in Brazilian pension funds were applied to this test.[7] The use of a risk-based dynamic analysis allocation by a pension fund in Brazil depends on the allocation limits per segment, or investment classes. The 50% limit on investments to be allocated in variable income asset was introduced in the tests to reproduce the cap which the Brazilian pension funds are liable to. Allocations in Ibovespa over 50% only happened in a passive way, due to Ibovespa's appreciation compared to the investment in free risk asset. In this case, no additional allocation was made in risk asset, until it corresponded to 50% of the investment portfolio.

In Table 7 below are displayed the return on dynamic strategy with a 5% risk budget, 95% confidence level and 33 basis points brokerage, minimum negotiation limit of 3% the portfolio value and maximum variable income allocation of 50% of investments. For comparison purposes, the results from a maximum variable income limit of 100% are also displayed; the other parameters remain unchanged.

[7] Such limitation can also be extended to some investment funds.

TABLE 7: DYNAMIC STRATEGY RETURN ON VARIABLE INCOME ALLOCATION LIMIT

Year	Return on Dynamic Adjustment Strategy Maximum VI Allocation = 100%	Return on Dynamic Adjustment Strategy Maximum VI Allocation = 50%
1991	23.52%	42.81%
1992	-3.79%	-3.79%
1993	1.38%	2.09%
1994	-4.27%	-4.27%
1995	-4.34%	-4.34%
1996	3.13%	3.45%
1997	-5.38%	-5.12%
1998	-5.00%	-5.00%
1999	33.28%	24.29%
2000	-4.23%	-4.23%
2001	-4.65%	-4.65%
2002	-4.45%	-4.45%
2003	26.28%	17.79%
2004	0.54%	0.70%
2005	3.19%	3.19%
2006	3.80%	3.86%
2007	-4.26%	4.68%
Total	54.88%	72.82%
Average	2.61%	3.27%
Minimum Return	-5.38%	-5.12%

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, the defined lost limit is 5%. and the minimum negotiation limit is 3% the portfolio value. The transaction costs are considered in the strategy. The maximum variable asset allocation limit is 50% of investments. For comparison purposes, the results from a maximum variable income limit of 100% are also displayed; the other parameters remain unchanged.

The return on dynamic strategy with a 50% allocation limit was unexpectedly superior to return on a 100% limit. Under a more restrictive condition, less return was expected, but that was not the case.

Besides considerably reducing the portfolio's turnover and, further, brokerage expenses, the 50% variable income limit prevented the dynamic strategy from presenting excessively high allocation in those years with sudden trend alteration and slight recovery in the final months. In 1991, 1993 and 2007, the preservation of a largest portion of the risk budget allows allocation with lower exposure to variable income to regain its position in surges at the end of the year. In 2007, the 50% limit is not enough to preserve the risk budget, and there is no major difference regarding the 100% variable income limit. When the surge trend is permanent, the possibility of being more exposed in Ibovespa generated more return, as in 1999 and 2003. In downside years, the dynamic strategy return under both limits was much alike.

The results found motivated an investigation on the efficiency of adopting a variable income exposure limit. As observed in the previous simulation, the purpose of such limit is to prevent the dynamic strategy from excessively elevating the exposure to risk when there is a strong tendency of surge, when the market drops upon allegations of negative news. Using the same parameter of the previous simulation, Table 8 shows the effects of adopting limits between 10 an 100% in variable income allocation on both return and turnover.

TABLE 8: DYNAMIC STRATEGY RETURN AND TURNOVER PER ALLOCATION IN VARIABLE INCOME LIMIT

	Maximum Variable Income Allocation									
Year	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1991	16.19%	24.22%	32.63%	37.90%	42.81%	43.69%	41.24%	29.15%	24.03%	23.52%
1992	-2.66%	-3.79%	-3.79%	-3.79%	-3.79%	-3.79%	-3.79%	-3.79%	-3.79%	-3.79%
1993	5.02%	7.71%	5.87%	2.75%	2.09%	1.98%	1.91%	1.73%	1.56%	1.38%
1994	0.22%	-4.27%	-4.27%	-4.27%	-4.27%	-4.27%	-4.27%	-4.27%	-4.27%	-4.27%
1995	-4.34%	-4.34%	-4.34%	-4.34%	-4.34%	-4.34%	-4.34%	-4.34%	-4.34%	-4.34%
1996	1.93%	3.28%	3.55%	3.15%	3.45%	3.56%	3.24%	3.02%	3.06%	3.13%
1997	2.98%	4.03%	3.94%	-5.60%	-5.12%	-4.72%	-6.12%	-5.38%	-5.38%	-5.38%
1998	-5.14%	-5.00%	-5.00%	-5.00%	-5.00%	-5.00%	-5.00%	-5.00%	-5.00%	-5.00%
1999	8.20%	14.75%	18.18%	22.51%	24.29%	26.68%	28.58%	30.18%	32.02%	33.28%
2000	-1.99%	-4.23%	-4.23%	-4.23%	-4.23%	-4.23%	-4.23%	-4.23%	-4.23%	-4.23%
2001	-3.14%	-4.65%	-4.65%	-4.65%	-4.65%	-4.65%	-4.65%	-4.65%	-4.65%	-4.65%
2002	-3.41%	-4.45%	-4.45%	-4.45%	-4.45%	-4.45%	-4.45%	-4.45%	-4.45%	-4.45%
2003	5.45%	9.45%	13.11%	15.78%	17.79%	19.19%	21.12%	22.94%	24.69%	26.28%
2004	0.14%	0.18%	0.55%	0.85%	0.70%	0.70%	0.58%	0.60%	0.59%	0.54%
2005	0.22%	1.23%	2.29%	2.98%	3.19%	3.19%	3.19%	3.19%	3.19%	3.19%
2006	1.51%	2.44%	2.43%	3.30%	3.86%	4.32%	3.39%	3.46%	3.62%	3.80%
2007	2.93%	4.29%	4.38%	4.31%	4.68%	4.51%	3.08%	-3.85%	-4.24%	-4.26%
Total	24.40%	42.87%	62.24%	59.94%	72.82%	80.62%	75.53%	54.58%	52.10%	54.88%
Average	1.29%	2.12%	2.89%	2.80%	3.27%	3.54%	3.37%	2.59%	2.50%	2.61%
Minimum Return	-5.14%	-5.00%	-5.00%	-5.60%	-5.12%	-5.00%	-6.12%	-5.38%	-5.38%	-5.38%
Portfolio Turnover	16.3%	36.2%	57.8%	86.2%	106.5%	125.8%	173.2%	226.7%	253.5%	266.4%

Results refer to strategy with Selic-linked asset and Ibovespa from 1991 to 2007. The confidence level is 95%, the defined lost limit is 5%. and the minimum negotiation limit is 3% the portfolio value. The transaction costs are considered in the strategy.

The results found indicate that the use of a risk asset position limitation can improve risk-based dynamic allocation strategy return. The exposure limit prevents the assumption of higher positioning by the dynamic strategy every time there is a surge. At the beginning of surges, this attribute is positive, because surges cannot always be forecast. However, as of a certain amount of allocation, the risk is too high and the strategy may be

forced to zero its risky positions in case there are momentary losses that consume the loss reserve.

BACKTEST OF RISK-BASED DYNAMIC ALLOCATION STRATEGY IN *IB, IM* AND *IS ASSETS*

The dynamic strategy's backtest with two risk asset classes, even with a shortened investment horizon – from annual to half-year, cannot count on the big diversity of market situations. From the second half of 2004 to the first half of 2008, when the strategy return was calculated, the Brazilian financial markets were relatively calm compared to 1991-2003 period.

A 2.5% risk budget was used for each short-term investment horizon; 95% confidence level; 33 basis points transaction cost; minimum negotiation of 3% on the portfolio total and 50% limit on voluntary allocation in *IB* and 100% in *IM*. Results of the strategy and the fixed allocation throughout the short-term investment horizon are displayed in Table 9.

TABLE 9: RETURN NET OF ALLOCATION TRANSACTION COSTS WITH AND WITHOUT DYNAMIC ADJUSTMENT USING TWO RISK ASSETS.

	Fixed Allocation			Strategy Return with Dynamic Adjustment
Period	*IB Allocation*	*IS Allocation*	Return	
2nd Half 2004	6.9%	5.7%	1.0%	2.7%
1st Half 2005	9.8%	8.6%	-1.4%	-2.6%
2nd Half 2005	9.3%	8.1%	1.9%	2.4%
1st Half 2006	9.9%	8.7%	0.0%	-2.6%
2nd Half 2006	10.5%	9.3%	2.1%	2.5%
1st Half 2007	7.8%	6.7%	1.6%	2.8%
2nd Half 2007	8.8%	7.6%	0.7%	-1.9%
1st Half 2008	9.2%	8.2%	-0.3%	-1.8%
Total			5.71%	1.35%
Average	9.04%	7.89%	0.70%	0.17%
Minimum Return			-1.43%	-2.56%

Results refer to strategy with Selic-linked asset, Ibovespa and inflation-linked asset for the period between the second half of 2004 and the first half of 2008. 95% Confidence level, 2.5% loss limit and minimum negotiation limit of 3% on the portfolio value. The transaction costs were taken into consideration.

Although the return on the full strategy was positive for the period, it was lower than the results from allocation with adjustment in the beginning of the period, according to parameters of risk-based allocation. When the dynamic strategy had positive return, they were higher than those by fixed allocation, which means that the dynamic strategy managed to absorb gains during surges in risk markets.

In two periods, the first half of 2005 and 2006, the dynamic strategy slightly exceeded the risk budget. In general, the tests with two risk assets did not prove the dynamic strategy to be clearly more advantageous. The return of the tested period does not seem to justify the need to estimate many parameters and operational difficulties needed to implement it. Such results are contrary to those found in the work by Herold et al (2007).

CONCLUSION

This essay wanted to investigate dynamic reallocation amongst the major asset classes in the Brazilian market. The used methodology was based on Herold et al. (2007)'s work to replicate pension fund investment strategies

The study deeply investigates the influence of variables 'loss limit', 'confidence level', 'transaction costs', 'minimum negotiation level' and 'variable income allocation limit'.

The risk-based total return strategy backtest showed a few market situations where its application was potentially profitable and others where it should be avoided. Return on tests where Ibovespa was the only risk asset was compatible with the purpose to limit short-term losses and generate long-term positive return. Besides, the dynamic strategy was proven capable of absorbing gains when risk assets were too low, reflecting an adverse political or economic situation. On the other hand, its use in markets with strong surges was not appropriate, as the continuous positioning elevation extended the loss limit. Another explanation is the uncertainty as to the stability of the parameters needed for it to work. As the market behavior changes constantly, automatic allocation strategies result in losses.

As it goes with all models depending on the use of standard deviation projection, the risk-based dynamic allocation strategy is limited by the use of past data to establish this parameter. The application of the EWMA model to estimate the standard deviation for risk asset series, however, usually improves the perception of a change in behavior. The estimated risk variables by normal distribution are also a study limitation, inherent to models involving unknown population distribution figures.

The use of closing quotes to calculate the strategy's dynamic allocations can generate different results from those obtained under real circumstances. Even assuming the use of really liquid assets in allocations, it is unlikely that the asset operations happen exactly under closing quotes. As usual, according to the strategy's logic, the position elevation in risk asset occurs during surges and vice-versa; it is possible that, if prices are

discontinued or assets are not liquid, those operations devised in the simulation may not happen this way. The last limitation on this research is that the propagation of cyclic dynamic strategies can feed back the initial market movements, whether up or down, which turns them from price takers to price inducers. Thus, the strategy would contribute to create bubbles or irrational depreciation of asset prices.

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