Elma Agic-Sabeta. 2017. Portfolio Insurance Investment Strategies: A Risk Management Tool.
UTMS Journal of Economics 8 (2): 91–104.

Review
(accepted September 26, 2016)

PORTFOLIO INSURANCE INVESTMENT STRATEGIES: A RISK-MANAGEMENT TOOL

Elma Agic-Sabeta[1]

Abstract
Unsystemic risks in financial markets may be reduced through diversification. Systemic risks relate to the overall economy, cannot be influenced by a single company, and require special attention. Empirical research on return distributions in the long-term shows that investing under the assumption of normal distribution of returns may be dangerous. The main objectives of this article are to describe portfolio insurance strategies and investigate their advantages and disadvantages. Furthermore, their use in financial markets in both developed and emerging markets is explored, with special consideration placed on southeast European markets. Theoretical models are reviewed, including recent research articles in the field. The results are analyzed, summarized, and presented in the form of tables and graphs. The main finding of the article is identification of strategies that could be used in southeast Europe. It concludes that implementation of portfolio insurance strategies by asset managers may reduce financial risks in southeast European markets if implementation is done professionally and, simultaneously, it is monitored during the entire investment horizon.

Keywords: asset management, alternative investment strategies, asymmetric return profile.

Jel Classification: G110

INTRODUCTION

In the asset allocation process, analyses of historical data and forecasts are prepared in order to produce investment decisions. Louis Bachelier provided significant contribution to financial theory in 1900 by discovering that price changes in stock markets followed a normal distribution and that most variations were small. This discovery allowed stock price changes to be shown on a relatively narrow bell curve. However, financial theorists after him (e.g., Mandelbrot 1963; Blattberg and Gonedes 1974) found that significant deviations from normal curves may occur. These deviations are the results of extreme events, and in statistics they are known as outliers. In finance, these deviations are called fat tails.

Skewness and kurtosis are statistical indicators that measure deviations from the normal curve. Skewness describes the asymmetry of a distribution around its mean. For

[1] **Elma Agic-Sabeta,** PhD, Bosna Bank International, Sarajevo, Bosnia and Herzegovina.

a normal distribution, the skewness is zero because of its symmetry around the mean. A distribution is skewed when positive and negative returns around the mean are not equally likely (Adiliberti 2001). Negative skewness suggests that the distribution is skewed to the left, and vice versa. Risk-averse investors prefer right-skewed instead of left-skewed distributions. The symmetry characteristics of return distributions play a major role in option strategies, in which asymmetric performance profiles are obtained. The measure of skewness has great significance for portfolio insurance (Bruns and Meyer-Bullerdiek 2003).

Kurtosis indicates the peakedness or the flatness of the distribution. The distribution is kurtosis if the peak of the returns is higher and narrower than implied by normal distribution. Both fat tails and the kurtosis feature are referred as leptokurtosis. A more peaked distribution shows the characteristics of higher leptokurtosis, and it is also known as thin-waist. The phenomenon of kurtosis is also described as the volatility of the volatility (Adiliberti 2001).

Events such as the fall of the S&P 500 index by 11.6% on September 11th, 2001 or a dramatic increase of the NASDAQ composite index by more than 14% on January 3rd, 2001 are rare and their probability is very low. Unfortunately, it is exactly these events that cannot be captured by normal distributions when plotting returns on a return distribution curve (MIT Sloan, Investments).

1.1. Empirical findings

Figure 1 shows a histogram density function for the S&P 500 and Bund daily price returns in order to support the theoretical findings above. The daily price changes have been logarithmized in order to obtain continuous returns using the formula:

$$\ln\left(\frac{S_{t-1}}{S_t}\right) \tag{1}$$

Time series of index levels of the S&P 500 and German Bunds (long-term government bonds) were drawn for the observation period from January 3rd, 1994 to May 13th, 2005. Afterwards daily returns were calculated and the results shown in a histogram. The Bund's time-to-maturity is about 11 years. In the histogram there are fat tails at the left and right ends, which are more pronounced for the equity index than for bonds. In addition, daily returns were significantly higher for bonds than for the equity index. The annualized mean return for bonds was 2.15%, and the annualized standard deviation 9.06%. In contrast, stocks' annualized returns were −7.98% and the standard deviation was 17.61%.

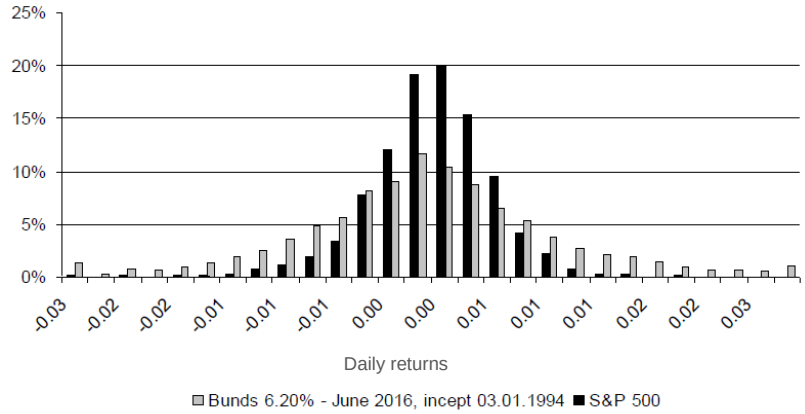

Figure 1. Histogram density function for the S&P 500 and Bund daily price returns
Source: JPMorgan data query and personal calculations

In Figure 2, the S&P daily returns frequency distribution from August 26th, 1993 to January 19th, 2001 has been graphed by using current and normal distributions of daily returns. The right and left ends of the normal curve show deviations of the current distribution from the normal curve; namely, the fat tails already mentioned. These deviations indicate how large the risks are for investors. The left tail shows the probability of negative deviations, whereas the right tail shows the opposite. Furthermore, the peakedness of the current distribution as well as its narrowness are obvious. Therefore this current distribution can be defined as considerably leptokurtosis.

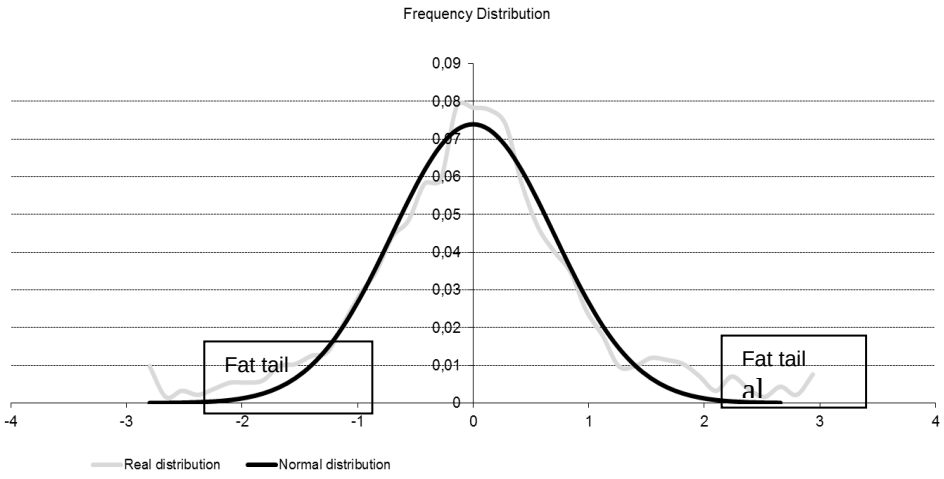

Figure 2. S&P daily returns, current and normal distribution, August 26th, 1993–January 19th, 2001
Source: JPMorgan Data query, personal calculations

The 5th percentile on the left side amounts to −1.6%, whereas 5th percentile on the right side amounts to 1.63%. This implies that there is 5% probability that the result will be below −1.6% and above 1.63%. The next figure presents an extract from the previous graph in order to focus on the left fat tail of the daily distribution. The 5% probability of loss can be seen in the dashed box. The negative deviations, meaning the greater losses than implied by the normal distributions, are quite significant.

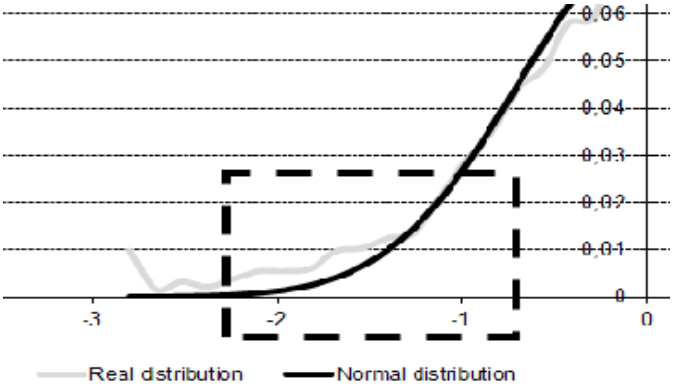

Figure 3. Fat tail of the daily return distribution of the S&P 500 index, 5% on the left side

Source: JP Morgan data query, personal calculations

By looking into empirical findings from the aspect of asset management, it can be concluded that the process of risk management and risk reduction is a very demanding task. This article investigates theoretical and practical solutions for investment management under the assumption of a high degree of uncertainty.

This article is organized as follows: after the introduction, which describes the background of the problem, the empirical findings section supports the theoretical concepts mentioned. Furthermore, the concept of portfolio insurance is described. In the second part, a set of portfolio insurance strategies is presented, including advantages and disadvantages and comparisons between different strategies. The third part presents examples of using portfolio insurance strategies and focuses on southeast Europe. The conclusion summarizes the article and suggests further research.

1.2. Portfolio theory

The key expectation of investors is maximization of returns while at the same time keeping risks at the minimum level. Thereby, the main feature in constructing portfolios is a risk to expected return ratio, invented in the framework of Portfolio Theory. Markowitz (1952) proved that risks can be minimized by selecting different securities. More importantly, not only the absolute risk of individual securities, but the correlations between them are crucial in effective portfolio construction. He proved that portfolio risk is not simply the sum of individual stock risks, but that picking stocks from different

companies exposed to different kinds of risks can reduce the total portfolio risk, in which 1 + 1 does not simply equal 2.

1.3. Portfolio insurance

Unsystemic risks in financial markets can be reduced through diversification. Systemic risks can be managed by using portfolio insurance strategies (Steiner and Bruns 2002). The founders of the portfolio insurance concept are Leland and Rubinstein.

The main goal of portfolio insurance is protection against downside risk, allowing upside participation in the case of favorable market development. These strategies limit undesired loss, but the possible profit is decreased by the amount of option premium that has to be paid. This exactly reflects how investors see risks; namely, they consider risky returns below some certain value and are less concerned with the return's volatility (Laurent 2003). The concept's objective is to achieve a convex function of the portfolio in a specific investment horizon (Engelman 2002). In general, convex strategies offer good downside protection. They perform well in upside markets. However, they tend to achieve poor results in flat but oscillating markets. Convex and concave payoff structures are mirror images of one another. In the framework of this theory, the seller of the convex structure is at the same the buyer of the concave structure (Perold and Sharpe 1995).

2. TYPES OF PORTFOLIO INSURANCE STRATEGIES

A wide range of portfolio insurance strategies are used in practice, and researchers and practitioners are constantly inventing new strategies. The main classification of portfolio insurance strategies is made into static and dynamic strategies, as shown in Table 1. Static strategies are set up once and do not require any further adjustments until the end of the investment horizon. In contrast, dynamic strategies must be continuously supervised and adapted based on price changes in financial instruments. Furthermore, portfolio insurance strategies can be divided into option-based or option-duplicating strategies and derivative-independent strategies. Each strategy is briefly described below.

Table 1. Classification of portfolio insurance strategies

Option or spot strategies	Static Approach	Dynamic Approach
Option Strategies	Protective put	Protective put with delta hedging
	Long call, covered call	Long call with delta adjustments
Option Duplicating Strategies		Synthetic protective put
		Synthetic long call
Spot Strategies	Stop-loss	Constant-proportion portfolio insurance
		Time-invariant portfolio insurance

Note: based on: Laurent (2003) and Rudolf (1994).

2.1. Static portfolio insurance strategies

The *stop-loss* strategy may be implemented either by using options or without options. Stop-loss based on options is a strategy in which an unsecured out-of-the-money option is held until the option is in the money (Hull 2001). An option-free stop-loss strategy is one in which the asset is sold whenever its price falls below a limit set by the investor. This strategy is executed without any additional costs by the brokers. Nevertheless, the strategy includes the weakness that that the investor will not participate in any further price increase above the limit unless the asset is bought again (Laurent 2003).

Protective put is a classic static option-based portfolio insurance strategy. This strategy is a combination of a long position in an asset and a long position in a put option on the same asset (Laurent 2003). It is appropriate in situations when the investors want to invest in stocks but are not willing to bear potential losses beyond some given level (Bodie, Kane, and Markus 2005). Figure 2 shows how protective put secures the stock against loss, where: S_o = stock price, X = exercise price, P = option premium, and S_r = value of stock at expiration. This shows what the general return profile of portfolio insurance strategies look like. Such an investment profile is called an asymmetric return profile.

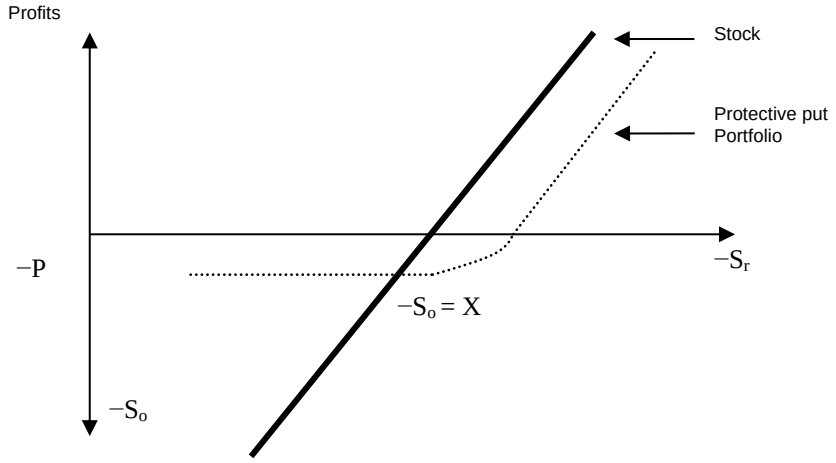

Figure 2: Protective put vs. stock investment
Note: Based on: Bodie, Kane, and Markus 2005.

The protective put strategy offers insurance against stock price declines by limiting its losses. The cost of the protection is that, if the stock price increases, the profit is reduced by the cost of the option premium—namely, the put option (Bodie, Kane, and Markus 2005).

The payoff of a protective put can also be obtained by a *long call strategy* by achieving a long position in a call option on an asset and a long position on a risk-free money market instrument (Laurent 2003).

Calls on stock indexes as well as calls on individual options can be bought. For instance, by selecting fixed-interest assets (zero-bonds), with the appropriate residual maturity, the repayment of a zero-bond at the end of the period represents the minimum

portfolio value. The long call strategy is also called the 90/10 strategy, where 90 stands for the proportion of the risk-free asset and 10 for the proportion of risky asset. However, these proportions are not fixed (Steiner and Bruns 2002).

By buying stocks with simultaneous sale of call on that stock, the position of *covered call* is obtained. The expression *covered* is used because the potential obligation to deliver the stock is covered by the stock held in that portfolio (Bodie, Kane, and Markus 2005).

2.2. Dynamic portfolio insurance strategies

Synthetic positions are obtained through a combination of specific positions from option and/or future trading or from future and spot trading. Common synthetic strategies are: synthetic stock positions, synthetic bond positions, synthetic options, and futures positions (Zahn 1991).

The *synthetic protective put* strategy is based on the option pricing theory. European puts can be duplicated through selling a stock and combined with risk-free interest investments. In order to implement a synthetic put, we need to define how many stocks have to be sold and what amount has to be invested in risk-free assets. Finally, five determinants influence the share of the amount of stocks to be sold and risk-free assets to be bought, which are the:

a) Actual stock price (*K*)
b) Strike price (*B*)
c) Volatility
d) Maturity
e) Risk-free interest rate

Put delta is the ratio that shows the number of stocks per selling option in a hedge portfolio, and it can be calculated with the input of the factors mentioned above. The strike price has to be determined before through iterative mathematical calculation. The strike price must be the one in which, in the case of a put exercise, the desired floor is preserved:

$$\mathrm{B} = \frac{F}{\mathrm{V}_0} * (\mathrm{K}_0 + \mathrm{P}_0\,(\mathrm{B})) \tag{2}$$

V_0 is the portfolio value at the beginning of an investment horizon, the ratio F/V_0 is a percentage of floor, and P_0 is the put price at the beginning of an investment horizon. Because the synthetic put has to be financed, the strike price is usually higher than the floor. Delta values can be calculated through the determination of d_1. The share of stock can be calculated as follows:

$$W_{\mathrm{ASP}} = -N(d_1) * K_{\mathrm{t}} \tag{3}$$

where $d_1 = \dfrac{\ln \dfrac{B}{K} - (\ln(Rf) + 0{,}5 * \sigma^2) * t}{\sigma * \sqrt{t}}$

The share of a risk-free asset (W_B) is calculated as follows:

$$W_{\mathrm{B}} = P_{\mathrm{t}} + -N(d_1)\, K_{\mathrm{t}}, \tag{4}$$

where P_t is a put price in time t according to the Black–Scholes formula. The share of risky asset is calculated as follows:

$$W_A = (1 - N(d_1) * K_t \quad (5)$$

Depending on stock market conditions, the shifting of assets in risky and risk-free positions must be adapted regularly with the help of the delta value (Steiner and Bruns 2002).

Constant-proportion portfolio insurance (CPPI). Black and Perold (1992) responded to the desire for protection against downside risk with a new method of portfolio insurance. The investor's equity is allocated dynamically over time. The share of initially invested capital that should be preserved during the investment horizon called the floor is determined by the investor. The difference between the actual portfolio value and the floor is known as the cushion. The cushion is then multiplied by the leverage factor, named the multiplier, and invested in the risky part of the portfolio. The total amount allocated to risky assets is called exposure, and it can be calculated as follows:

Exposure = multiplier * cushion

The rest of the assets are invested in risk-free assets, which are usually treasury bills or other liquid money market instruments. As seen, both the floor and the multiple are functions of the investor's risk tolerance (Rudolf 1994). For instance, the cushion might be 5 and the floor might be set at 80 percent of original wealth, resulting in an initial equity allocation of 100 percent. The investor participated fully if the market went up. If the stock market went down, the portfolio became increasingly conservative, asymptotically approaching 100 percent cash equivalents when 20 percent of the original wealth was lost (Wilcox 2004).

The higher the multiplier, the more the investor will participate in the stock price increase. On the other hand, the higher the multiplier, the faster the portfolio will reach the floor when the fall of stock prices continues. When the cushion approaches zero, the exposure approaches zero as well. In continuous time, this keeps the portfolio value above the floor. The decrease of the portfolio value below the floor is possible only when there is a sharp fall in the market before the investor has the chance to trade (Bertrand and Prigent 2002).

The advantage of this strategy over other approaches is its simplicity and its flexibility (Bertrand and Prigent 2002).

One example of further developments of the CPPI strategy is the *time-invariant portfolio protection strategy* (*TIPP*). TIPP is a dynamic derivative-free portfolio insurance strategy. The main difference between CPPI and TIPP is in setting the floor. Whereas in CPPI the floor is set up once, in TIPP the floor value can continuously be adapted to the changes in the portfolio value (Laurent 2003). The TIPP strategy proved to be more successful than CPPI, especially under volatile markets.

2.3. Comparisons

Stop-loss vs. dynamic strategies: Pellser and Vorst (1993) have analyzed how various strategies perform when transaction costs are taken into consideration. Their studies have shown that dynamic strategies achieve better results than the stop-loss strategy, in spite of active trading (Rudolf 1994).

Synthetic protective put vs. CPPI: Empirical studies have shown contradictory results on the synthetic put approach. Huu Do (2002) compared the performance of the synthetic put approach with CPPI under various implementation scenarios, meaning different floors, rebalancing intervals, and volatility. The main conclusions were the following:

- Both strategies ensure downside protection by optimally shifting funds into the risky asset and away from cash as the market rises, and into cash and away from the risky asset as the market falls.
- CPPI dominates in scenarios using daily rebalancing, whereas the synthetic protective put strategy delivers better results when a market move triggers rebalancing.
- Researchers blame CPPI for being heuristic, or not including data for analytical study; for instance, there is no theoretical basis to choose the parameters for floor and multiple to make possible a comparative evaluation between these two models.

2.4. Disadvantages of portfolio insurance strategies

Static portfolio insurance strategies, including stop-loss, protective put, covered call, and the long call approach, are based on the Black–Scholes option pricing model. The crucial difficulty is that any deviations from this model put the whole concept in danger of not achieving the desired results. The second disadvantage of static portfolio insurance strategies is the danger that the realization of the strategy will not be possible at all due to the non-existence of a necessary contract design. Usually, standardized options are easily available on the market, but this is not the case with individually created options (Rudolf 1994).

Empirical studies have shown that risk reduction through portfolio insurance is not free of charge. In times of declining markets, insured portfolios perform better than the market. In contrast, when markets are rising, lower performance is achieved by portfolio insurance strategies. In addition to high opportunity costs, high transaction costs are an additional point that speaks against the use of these strategies. Furthermore, the risk is still present in the market (Steiner and Burns 2002).

The main difference between stock-traded options and dynamic strategies is that, in the first, supply and demand are balanced through option prices, whereas in the latter this is missing. This means that the success of the specific dynamic strategy strongly depends on how many other market participants use a similar strategy. Whereas in stock-traded options over-demand can be regulated by higher prices, this balancing mechanism does not exist in the case of dynamic strategies (Zimmermann 1996).

The effectiveness of portfolio insurance is based on the assumption that the speed of market changes is slower than the speed of order execution. This was presented in the first work by Leland and Rubinstein. Because this is not always the case, during huge market moves portfolio insurance can have counter-effects (Loistl 1996).

Researchers have identified several real-world determinants that can seriously damage the synthetic put strategy, which are: uncertain interest rates, large jumps in price movements, security mispricing, transaction costs, and volatility mis-estimation. Any deviations from the Black–Scholes model's assumptions will lead to replication errors,

making the strategy path-dependent. Replication error is defined as the opportunity cost of investing in a synthetic option instead of implementing a put strategy (Huu Do 2002).

Jacobs, one of the biggest opponents of portfolio insurance, has proven by simulating a synthetic put approach with a 95% protective floor that it can be effective in the short term but not in the long term. The results are presented in Table 2, where hedging in stock and cash includes transaction costs of 0.5%, and hedging with futures does not have any transaction costs (Huu Do 2002).

Table 2. Return on investing USD 1 using different investment strategies

Investment horizon	10 yrs., 1972−1982	55 yrs., 1928−1982
Hedging in stock and cash	USD 2.29	USD 36.97
Hedging by futures	USD 2.43	USD 52.36
Investing in the S&P500	USD 1.9	USD 104.25

Note: Based on Huu Do 2002.

2.5. Disadvantages of CPPI

Path dependency describes the fact that the final portfolio value depends not only on the market condition at the end of the investment horizon, but on the course-development in between. The risk buffer in the case of CPPI is invested not only one time in the market, but *m* times. Accordingly, risky asset exposure and the participation in an upside market is greater than before. Greater upside potential is obtained through quicker disinvesting during falling courses, which can result with complete shifting into risk-free assets. This enhances the path-dependency of CPPI (Kloy 2004).

At a time when markets are highly volatile, we are a bit late with our actions on the market. In such markets, when the movements do not occur according to any rules, the mechanics of the strategy tend to result in portfolio managers buying stocks with higher risks at high prices and selling those at lower prices. This continuously lowers the portfolio performance (Bossert 2002).

When the market is falling very fast, the result is that all assets are invested in risk-free assets. The situation in which all assets are invested in risk-free assets is described as *cash-locked*. When the stock index reaches low levels, at which there is no risk-buffer any more, CPPI sets risky assets at 0 and can no longer participate in a market rebound (Cowperthwaite 2002).

Numerous studies were performed in order to prove or disapprove the connection of portfolio insurance with the stock market crash in 1987. The crash caused a fall not only in the US market, but across the world (Rubinstein 1988). Whether portfolio insurance is positively correlated with stock market volatility depends on how smoothly the market absorbs the deals implemented through portfolio insurance. If portfolio insurance is only a small portion of the entire trading, there should be no consequences. The broader use of portfolio insurance results in destabilizing effects on the market (Hull 2001). Brennan and Schwartz argue that portfolio insurance increases market volatility in a pure-exchange economy, in which agents are modeled as having objectives only to achieve profit at some portfolio insurance horizon (Bassak 2001).

3. USE OF PORTFOLIO INSURANCE STRATEGIES IN PRACTICE

3.1. Developed financial markets

Portfolio insurance investments have been more prevalent in Europe than in the United States. The main investors in portfolio insurance products are high-net-worth individuals, private banks that purchase products for onward sale to their clients, and institutional investors such as pension funds. (Pain and Rand 2008). Currently, CPPI-based products usually include options (Kosowski and Neftci 2015).

American pension funds have secured their stocks using option-based portfolio insurance since 1985. The time horizon of insurance is approximately three years (Eilenberger 1996).

Products based on synthetic protective put and the CPPI principle may be obtained by private and institutional investors from investment banks, commercial banks, and investments funds. Various options that offer protection against the main disadvantages of the portfolio insurance strategy may also be obtained. However, each additional product feature results in additional costs and can sometimes result in a bad outcome if the market develops in an undesired direction. Therefore, close attention must be paid when choosing various additional features of the portfolio insurance product.

The CPPI strategy may be implemented by investing in the stock index of developed markets, emerging markets, real-estate, hedge funds, and so on (Gregoriou 2008). CPPI strategy, its pricing and implementation methods have been studied by scientist across all major financial markets, including those of emerging and developing nations as it may be seen in research papers on Chinese market (Jiang et. al. 2009), Turkish market (Iscanoglu-Cekic 2016), Malaysian market (Masaar et al. 2012) etc.

3.2. Financial markets in southeast Europe

Use of portfolio insurance investment strategies is very limited in southeast Europe. As a result, large financial losses occur because various financial risks are not managed. An example of this is a Bosnian public company that registered a loss of EUR 3 million in 2010 as a result of an unhedged foreign exchange position (Elektroprivreda 2010).

Some countries such as Slovenia and Croatia are more advanced in this field. The volume of financial derivative contracts in Croatian banks in 2010 was equal to one-third of total bank assets. The derivatives are primarily used by banks to hedge their interest and currency risks (Croatian National Bank 2010). Other countries in the region such as Bosnia, Serbia, Macedonia, and Montenegro do not report on derivative usage in the banking sector, but direct contact with supervisory bodies of financial institutions resulted in information on very low or missing use of derivatives (Banking Agency of the Federation of Bosnia and Herzegovina, National Bank of Serbia).

There are very few studies on the use of financial derivatives in southeast Europe by non-financial companies. Milos Sprcic (2007) analyzed the use of financial derivatives by nonfinancial companies in Slovenia and Croatia. She found that forwards and swaps are mostly used. Futures are more intensively used in Slovenia than in Croatia. In Slovenia, derivatives are used more frequently than in Croatia. Complex derivatives are used only in Slovenia. Options are rarely used in both markets. The size of the company

was positively correlated with the use of financial derivatives in Slovenia. The main reasons for not using derivatives are high implementation costs of managing and maintaining programs for derivative transactions in Slovenia and non-availability of appropriate derivative contracts in Croatia. Rovcanin and Topalovic (2014) analyzed the use of financial derivatives in Bosnia and Herzegovina and found that the bank with the highest business volume of derivative transactions had ten contracts amounting to EUR 750,000 only. A study by Kozarevic, Kokorovic-Jukan, and Civic (2014) has shown that the main reasons for not using derivatives in Bosnia and Herzegovina were lack of knowledge about the benefits of derivatives of non-financial companies and bank personnel, and low exposure to financial risks due to a relatively low number of business operations on the global market by non-financial firms in Bosnia and Herzegovina. However, non-financial companies expressed a need for both basic and advanced training in financial derivatives.

Therefore, the use of financial risk reduction techniques in all regional markets should be enhanced in order to protect financial wealth.

CONCLUSION

Empirical findings showed that even in the long term and in large investment portfolios with a high level of diversification, such as the S&P 500 index, risks of large deviations from normal return distributions are present. Measures of skewness and kurtosis as a measure of financial risk in portfolio construction should be considered when analyzing the performance of investment strategies and making decisions in asset management. This article outlined investment strategies aimed at protecting investment portfolios. Their main advantages and disadvantages were analyzed and discussed using research articles. At the same time, it was found that these strategies are not used in southeast Europe. The conclusion for market participants is that the cost of not protecting investment portfolios and having open financial positions can be high. Use of financial derivatives is at a low level in the region, and there is generally a negative attitude towards these financial instruments in financial markets, especially for conservative investors. Hence, portfolio insurance strategies that do not use derivatives could serve as an attractive option for investing.

Portfolio insurance strategies contain both advantages and disadvantages, and only well-trained professionals should be using them. However, the existence of disadvantages does not mean that such strategies should not be applied in the markets of southeast Europe.

Based on the empirical findings in developed markets, and higher volatilities in developing financial markets, it is evident that financial risks should be carefully managed. Comprehensive research should be undertaken, in which the negative financial effects of not managing financial risks by various techniques in southeast European companies is quantified. Such risks could arise as a result of foreign exchange transactions, interest rate movements, equity risks, or other factors.

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