



## CHANGING THE NATURE OF STOCK RISK OVER TIME THE LONG-TERM ASPECT

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### ABSTRACT

**Background:** The risk of stock return is of paramount importance for a stock trader, but for an investor who owns an investment portfolio or stocks for a long time, the risk associated with a sharp drop in stock prices, usually characteristic of a stock crisis, or crisis risk comes first. The timing of the stock market crisis and its duration are unknown, and historical analogy is usually used for its approximate forecasting. **Purpose:** The study proposes theoretical model that represented relationship between stock price and company's equity per share depending on a number of main economic indicators. **Results:** If we proceed from the position that a stock crisis occurs when the stock price significantly exceeds its economic basis in the form of the company's own capital, then it becomes possible to assess the crisis risk by the degree of excess of the stock price of its objective basis. However, as the analysis shows, such a basis is not directly the equity capital of a joint-stock company, but such a value that reflects both the use of borrowed capital and the most important proportions of profit distribution, which are characteristic both for an individual company and for the stock market as a whole. Therefore, as an indicator of crisis risk, it is proposed to use a coefficient showing the ratio of the actual excess of the price over its economic basis to the normative, or economically justified, excess. **Conclusion:** Calculations of the crisis risk index can be useful for predicting "soap bubbles" in the stock market and stock crises.

**Keywords:** Stock price; Return; Stock crisis risk; Short-term volatility; Stock price uptrend; Stock market risk.



## A ALTERAÇÃO DA NATUREZA DO RISCO DE STOCK AO LONGO DO TEMPO O ASPECTO A LONGO PRAZO

### RESUMO

**Contexto:** O risco de retorno das ações é de suma importância para um corretor de ações, mas para um investidor que possui uma carteira de investimentos ou ações por muito tempo, o risco associado a uma queda acentuada nos preços das ações, geralmente característico de uma crise bolsista, ou risco de crise vem em primeiro lugar. O momento da crise do mercado de ações e sua duração são desconhecidos, e a analogia histórica é geralmente usada para sua previsão aproximada. **Objetivo:** O estudo propõe um modelo teórico que representou a relação entre o preço das ações e o patrimônio líquido por ação da empresa em função de alguns dos principais indicadores econômicos. **Resultados:** Se partirmos da posição de que uma crise acionária ocorre quando o preço da ação supera significativamente sua base econômica na forma de capital próprio da empresa, então torna-se possível avaliar o risco de crise pelo grau de excesso do preço da ação da sua base objetiva. No entanto, como mostra a análise, tal base não é diretamente o capital social de uma sociedade anônima, mas um valor que reflete tanto o uso de capital emprestado quanto as proporções mais importantes de distribuição de lucros, características tanto de uma empresa individual e para o mercado de ações como um todo. Portanto, como indicador de risco de crise, propõe-se a utilização de um coeficiente que mostre a relação entre o excesso real do preço sobre sua base econômica e o excesso normativo ou economicamente justificado. **Conclusão:** Cálculos do índice de risco de crise podem ser úteis para prever “bolhas de sabão” no mercado de ações e crises bolsistas.

**Palavras-chave:** Preço das ações; Retorno; Risco de crise das ações; Volatilidade a curto prazo; Tendência de subida do preço das ações; Risco do mercado de ações.

### 1 INTRODUCTION

Stock price does not reflect directly a monetary and tangible basis, for example, in the form of production costs, as the same as, any market price, the stock price is a result of interaction between supply and demand. The demand on a stock is determined by the amount of buyers' wealth (investors). While the supply is determined by the number of free-float stocks, which is offered for sale at any given time by stockholders. When the investor holds the stock for a long period on purpose of long-term investment his future cash flow would be equal to his dividends, as the holded stock drops out from the public trading in the stock market and does not participate in the supply formation, and from the formation of the market price (Berzon, 2013; Farma, 1970, 1991).

The investor as a stock seller would choose between two options: achieve capital return from selling the stock and turn to other investment or achieve a net cash income



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from a continuance speculation process. In the first option, the investor would stop participating in trading process in this stock in future, as he would invest in other stock or in other marketplaces. In the second option, the investor would sell the stock then turns into buyer of this stock. Thus, the investor will repeat this process again and again during the investment time period (Fisher 1960, 1975).

With regard to short time periods of investment, the size of supply and demand for a stock is completely random, therefore, its price is characterized by chaotic (unpredictable) fluctuations, i.e. the short-term returns would follow the normal distribution in a mass market. Since the dividends on a stock are not paid more than once a quarter or even less frequently, the only type of systematic daily (short-term) net income from a traded share is the monetary difference in its prices over time.

Therefore, short-term fluctuations in stock prices are the only cause of short-term volatility in its returns. The short-term return of a stock is a function (resulting) of fluctuations in its price, but not a function of its price itself. The level of short-term profitability of the share price is directly related to the range of price fluctuations over a selected period of time. The shorter the period of time, the relatively lower the stock's return for this period (Taleb, 2008; Watsham & Paramou, 1999).

While investing for longer period, contain a greater range of price fluctuations and a higher profitability of the stock. But, starting from a certain value of the time interval, the connection between the growth of the time interval and stock profitability stops, due to the fact that fluctuations in stock price over time are limited by limits of change in supply and demand for it. For example, the maximum volume of supply does not exceed the number of free- float stocks, and volume of money demand is limited by the amount of free cash from the stock buyers, which is associated with opportunity cost of investing in more profitable instruments at this period of time (Galanov, 2021; Galanov et al., 2017).

Since the interests of stock market parties are opposed in buying and selling operations, the price difference is always an income for some traders and a loss for the others. Thus, based on the possible magnitude of short-term fluctuations in the stock price, it is possible to predict not only the expected future profitability of the stock, but also its possible losses in the future. To do this, authors usually use the relative statistic like “standard deviation” (and its square is the variance). The standard deviation indicating the future time period is called “stock return risk” or in short “stock risk”. The word risk usually used to mean a potential future loss, in the same way the standard deviation is calculated, to show potential gain and potential loss. Also, in



standard deviation, potential profit and potential loss have the same meaning in quantitative terms.

The difference in stock price, depends on which side of the transaction it belongs to, is either a cash gain or a financial loss. In stock market, net income from stock trading is just another name for net loss. That is why, within a short period of time, the well-known principle of the stock market is observed: the higher the profitability of a stock, the higher its risk and vice versa. This is automatically proven by the method of calculating the standard deviation (Mandelbrot, 1997; Markowitz, 1952; Peters, 2000).

In relation to stock trading, the distinction between return and risk makes economic sense only when there is an “exit” beyond the short-term time frame. In the long term, the return on a share is the result of the sum of paid dividends on it and the result of the tendency of stock price to increase over time. An increase in the stock price over a long time period is a change that caused by its random volatility around the mean (Taleb, 2020).

The upward trend in the stock price makes the existence of its mean value over the period unnecessary, and in contrast the risk concept in the form of standard deviation would be unnecessary too. It seems that in this case the profitability of the stock grows without any risk at all. But this is true if risk is understood as risk as a standard deviation, because as a risk inherent in the short-term time interval. It is logical to proceed from the fact that on long horizons there are completely different risks for the stock than on short periods. In practice, only calculations of stock risk for a year or for shorter periods of time are used. If, for example, an investor is going to own a stock for 10 (many) years, then its risk, determined by the results of current short-term stock trading, does not matter to him, just because he is not going to trade stocks all these years. Obviously, such an investor has a completely different type of risk associated with a longer period of ownership of the stock. Long-term risks include the risk associated with non-payment dividends and the risk of a stock market crisis, or in short, crisis risk. The possible non-payment dividends is risk not associated with stock trading, so we did not examine it in the current study (Sharpe, 1964).

From the historical practice of the market, it is known well that the upward trend of the stock price in a long term is interrupted by its rapid and large (strong, significant) declines that called stock crises, after which the stock price grows again to the levels before the crisis. Economically, there is no limit to the stock price growth due to fact that there are no limits to growth of productive (profitable) capital, which is expressed by the market price of the stock (Graham, 1949; Graham & Dodd, 1934; Marx & Engels,



1962).

The fact that the short-term risk of stock's returns is the same (slightly different) from year to year, and underlies the possibility of investing for the long term. Obviously, no investment (in the sense of a long-term investment of money capital) in stocks would be irrational if its risk increased in proportion to during investment time horizon.

In the case of long-term investment, the stock profitability increases in proportion to investment period. Assuming the rest factors are constant, the longer investment time horizon the larger role of the capital functions. At the same time, the risk of a large (crisis) fall in a stock price is no longer under the volatility risk or a return risk to the price mean value.

Crisis risk is qualitatively different from "normal" stock return risk in that the price continues to rise after a crisis, rather than simply returning to the levels before the crisis. Crisis risk is manifested in significant falls in stock prices in the stock market, the general expression of which is the fall of the stock index value. Market participants independently "decide" by what percentage a rapid fall in the stock index value, that persists for some subsequent period of time until the stock index value returns to its previous value. Theoretically, crisis risk in terms of its size exceeds the level of "volatility risk" i.e. it exceeds the mean value of stock return risk, which is easily monitored, for example, through the percentage of closing price changes (or any other market price percentage). The closing price fluctuates daily from fractions of a percent to several. In the stock market, a limit is set for price fluctuations during the trading day. When the price change reaches its limit, then stock trading is suspended for a while. In addition, client orders are usually not accepted if the price change reaches its limit the limit set by the market board. Such restrictions on daily price fluctuations aims preventing any "current" price manipulations. But if the market continues prices continuous "insist" declining in prices under the lower limit after stop trading, then this is already beginning of a stock market crisis (Burenin, 2017, 2017; Mirkin, 1995).

The crisis risk, or the risk stock crisis, is indeterminate neither by the timing, nor by the duration. The history of stock crises shows that they occur systematically over a number of years. In recent decades, major stock crises happen, as frequently as, every ten years, however, the coronavirus pandemic and the conflict between the Western countries and Russia have violated the previous pattern, but the modern stock crisis has every chance to far outstrip the previous. Like the economic consequences of post-war crises in terms of its duration in case of further continuation the special military operations in Ukraine.



Since the stock crisis manifests itself in a significant drop in stock prices of almost all companies, it can be assumed that its economic essence lies in “bringing” the stock price to its economic basis of the company size which it represents. The total market value of a company's stock is its capitalization. However, the company capitalization usually does not reflect the company size nor the its own assets.

The current study proposes theoretical model that represented relationship between stock price and company's equity per share (by equity we mean the company's funds from the placement of its stocks and the annual parts of the profit remaining in the company) depending on a number of main economic indicators.

## 2 METHODS

The current study uses Gordon Growth Model (GGM), as a discount rate basis, which acts as a simple formula for calculating the predicted stock price, as the following:

$$P = \frac{D}{g} \quad (1)$$

where:  $P$  - predicted stock price

$D$  - Value of next year's dividends

$g$  - Constant of discount rate

## 3 RESULTS AND DISCUSSION

If we assume that the capital can be in form of equity or in form of loan should have the same yield, then the interest on borrowed capital is equal to the dividend yield on equity. thus, the stock price is theoretically equal to the amount of equity per share. This follows the following process:

$$g = \frac{D}{K_s} \quad (2)$$

$$P = \frac{D}{g} = D \cdot \frac{K_s}{D} \quad (3)$$



$$P = K_s \quad (4)$$

where:  $P$  - predicted stock price

$D$  - Value of next year's dividends

$K_s$  - company capitalization per share

$g$  - interest rate on borrowed capital

Taking into account the functions of both owned and borrowed capital, to increase the return on equity by the difference between the profitability of total capital and the interest paid on borrowed capital. The current study introduces an additional economic indicator:

$$K_z = a \cdot K_s \quad (5)$$

$$D = V \cdot NPS \quad (6)$$

$$NII = n (K_s + K_z) \quad (7)$$

$$g = \pi \cdot n \quad (8)$$

where:  $K_z$  - borrowed capital per share

$a$  - the ratio of borrowed capital to the equity capital of the company, or the coefficient of financial leverage

$NPS$  - net profit per share

$V$  - dividend ratio to net profit of the company (net profit dividend per share)

$NII$  - the total profit of the company (net profit plus interest payable on borrowed capital; we calculate it from income tax to simplify this formula.

$n$  - the total profit ratio of the company to the capital operating per share.

$\pi$  - the interest rate ratio to the company profitability.

By applying indicators from (5) to (8) in original model (1) with some transformations:

$$P = \frac{D}{g} \quad (9)$$

$$P = V \cdot NPS/g$$

We get:

$$\begin{aligned}
 NPS &= \Pi - g \cdot K_z \\
 NPS &= n \cdot (k_s + k_z) - g \cdot k_z \\
 NPS &= n \cdot k_s + n \cdot a \cdot k_s - g \cdot a \cdot k_s \\
 NPS &= k_s(n + n \cdot a - g \cdot a)
 \end{aligned} \tag{10}$$

Now we substitute equation 10 into formula 9:

$$P = V \cdot k_s(n + n \cdot a - g \cdot a)/g \tag{11}$$

By the condition  $r = \pi \cdot n$ , we obtain the final formula:

$$P = V \cdot k_s(1 + n \cdot a - \pi \cdot a)/\pi \tag{12}$$

Since the indicator "a" is the ratio of borrowed capital to equity. On average, this indicator can be taken equal to 1, where theoretically the borrowed capital should not exceed the equity.

The "p" indicator shows interest rate to the profitability ratio of the company's capital. Under normal conditions interest rate should be less than return on capital rate. Suppose that the interest rate on average is a half of return rate, i.e. the profit that the borrowed capital brings is equally divided between own capital and borrowed capital.

The "c" indicator shows the dividend of the company's net profit. On average the dividend usually is a half of profits, i.e. dividends value can be calculated as 0.5.

After replacing the previous values of indicators in our model, we get:

$$\begin{aligned}
 P &= 0,5k_s(1 + 1 - 0,5 * 1)/0,5 \\
 P &= 0,5k_s
 \end{aligned} \tag{13}$$

The proposed theoretical approach shows that the stock price can be higher in one and a half times than the equity capital per share of the company's, when the stock price is close to the average of the equity capital functioning in normal market conditions. if we ignore specific numerical indicators in this model, then the stock price in market would exceeds the equity capital, which is represented in trading.

According to relation 12, it is possible to make an assessment of other stock price components in relation to its own capital. For example; if the company operates only



with equity. So, the indicator of financial leverage "a" is equal to zero, because.  $K_3 = 0$ . After replacing the value of "a" indicator in the relation 12, we get:

$$P = V \cdot k_s (1 + 0 - \pi * 0) / \pi$$

$$P = V \cdot k_s / \pi \quad (14)$$

Or:

$$P = k_n \cdot k_s \quad (15)$$

where:  $k_n$  – normative, or economically justified coefficient of stock price excess than the capital, it represents (equity capital per share);  $k_n = V/\pi$ , if "a=0". In a more general case, according to the formula 12,  $k_n = V \cdot (1 + a - \pi \cdot a)$

From the previous formula,  $V = \pi = 0,5 \text{ i. e. } (1 + a - \pi \cdot a)$

$V = \pi = 0,5$ , t.e.  $k_n = 1$  so:

$$P = k_s \quad (16)$$

In other words, if a company do not have debt capital, theoretically it is stock price is likely to be based on its equity per share value. So, according to formula 15, the stock price differs from its own capital by the coefficient " $k_n$ ", which, obviously, can fluctuate widely. The more the borrowed capital share's and dividend in profit increases, the more the stock price breaks away from equity, but the higher the interest rate in relation to the capital profitability the lower the borrowed capital share, also the closer the stock price to its own capital. Each of these indicators' "v" and "p" in the usual case is less than one. For example, a decrease in the denominator "p" can lead to a high increase in the stock price in relation to equity.

When a company works not only with its own capital, but also with borrowed capital, then the theoretical price of its stocks is already significant (in this numerical example,  $k_n = 1.5$  times) exceeds the cost of equity per share.

Such modeling allows the current study to assert that a certain excess of the company's capitalization over its assets (or excess of the company's stock prices of its own assets per share) is an economically justified (normal) phenomenon. In other words, the existence of the coefficient " $k_n$ " is an objective phenomenon. Presence of this a coefficient, which it's value "reasonably" may exceed one is an economic basis

for the stock price growth over time, that explain the rise of stock prices beyond the actual size of the company's' equity capital.

When the stock price begins to excess significantly from its economically justified value over the cost of equity per share, i.e. when the actual ratio of price excess over the capital systematically and significantly of its normative (economically justified value), then a phenomenon known as a “soap bubble” appears on the stock market, which in relation to an individual stocks necessarily ends in a sharp drop in price, and the same in relation to the market as this drop becomes the cause of begins a stock market crisis.

Depending on the above, this study purposes a market indicator for assessing the level of crisis risk for a stock company, as the following:

$$K_{pa} = \frac{k_{fa}}{k_{na}} \quad (17)$$

$$Kpa = k_{\phi a} / k_{Ha}$$

where:  $K_{pa}$  – stock crisis risk level

$k_{\phi a}$  – actual excess factor

$k_{Ha}$  – normative excess factor

The minimum level of crisis risk can be considered the level at which the actual coefficient 17 is equal to or does not exceed the standard coefficient. By monitoring the dynamics crisis risk levels, it is possible to predict how much the stock price is overpriced or underpriced compared to its economic basis, which is reflected in the equity capital size, and the proportions of the company's profit distribution.

Taking into account the market as a whole, this study assessed the level of crisis risk from two sides: by aggregating it for individual companies and their stocks and/or making calculations for the market as a whole. Thus, the proposed indicator of crisis risk can be calculated using formula (18), which is similar to formula (17):

$$k_p = k_f / k_n \quad (18)$$

where:  $k_p$  – crisis risk level of stock market as a whole

$k_f$  – actual excess factor

$k_n$  – normative excess factor

However, the excess ratio itself, in relation to the stock market as a whole obviously

can be calculated through the indicators of market capitalization and the total equity capital of companies, taken into account in the capitalization indicator:

$$k = F/k_{so} \quad (19)$$

where:  $k$  – normative or actual coefficient of excess

$F$  – capitalization of the stock market, i.e. the stock price and number of issued stocks

$k_{so}$  – total equity capital of stock companies, for which the stock market capitalization is calculated.

#### 4 CONCLUSION

The advantage of the proposed crisis risk indicator is that it contains the necessary reporting information base for both stock companies and the market as a whole. Calculations of this index for different periods of time between stock crises allow us to analyze how the proposed index has changed over time and how its value changes as the stock market approaches the crisis. Also, having an information base on previous years would make it possible to predict stock price bubbles. Hence, an approximate approach to predicting stock market crises.

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