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Ex-Ante Equity Risk Premia: Expectational Estimates Using Stock Market Returns Forecasts in the Emerging Equity Market

Summary: We estimated the ex-ante equity risk premium for the Republic of Macedonia, which is a young, small and open emerging market. We polled academics and practitioners for their expectations on the stock market index MBI10 as a proxy for market portfolio. The risk premium is the expected MBI10 return relative to a government bond yield. Using the Kolmogorov-Smirnov and Anderson-Darling goodness-of-fit tests we determined the best fitted statistical distribution, and consequently estimated the short-term ERP of 8.55 and long-term average ERP for the next 10 years of 7.76. The estimated ex-ante ERP is higher and similar as it is in the other emerging markets.

Key words: Emerging markets, Forecast, Market returns, Risk-free rate, Expected equity risk premium, Goodness-of-fit test.

JEL: G11, G12, G14, G31.

Investors, corporate managers, money managers and academics have a great interest in the proper assessment of the expected equity risk premium (ERP) - the difference between the expected returns of diversified portfolio of stocks and risk-free rate. The expected equity risk premium or *ex-ante* risk premium is an important estimate for making the right long-term financial decisions. Having that in mind and considering the large cross-border movement of capital, it is essential to properly estimate this number.

The intent of this paper is to address the problem of the nature of the expected equity risk premium in the emerging markets, and to suggest the most appropriate way for its estimation. We will do this through the case of the Republic of Macedonia, as a small and open emerging market, which is of the same nature, and bears the same characteristics as other emerging markets in the region of Southeast Europe and wider in the segment of the emerging markets. The characteristics that apply in a general sense in the emerging markets, are also reflected on this market. Emerging markets crucially differ from developed markets and thus, the approach to estimate the right expected ERP that should be a true picture of the price of equity risk should be adjusted accordingly. This paper uses improved and consistent methodologies to estimate *ex-*

ante equity premia based on equity market return forecasts using survey approach and indirectly derives the expected ERP.

The rest of the paper is organized as follows: Section 1 gives a look at the *ex-ante* equity premium as price of equity risk and the characteristics of emerging equity markets; in Section 2 a review of the literature is presented; the empirical methodology is described in Section 3; our dataset and estimation results are shown in Section 4; and Section 5 provides a conclusion.

1. Ex-Ante Equity Premium as a Price of Equity Risk: An Important Look on the Nature and Characteristics of the Emerging Equity Markets

Equity risk premium (ERP) is one of the most important parameters in corporate finance, capital budgeting and valuation. It is the price of risk that should compensate the risk-averse investors for undertaking risky investments instead of risk-free investment. Here, what matters is not the individual but the general risk aversion in the market as a whole and this parameter, called equity risk premium or market risk premium, is hard to estimate in the well-developed markets with a long history and even harder in small and open emerging markets. The proper estimation of this figure, especially in the case of emerging markets, most importantly requires a proper understanding of its nature. Generally, we can conclude that the nature of *ex-ante* equity risk premium seems not to be understood well. In their seminal paper on the equity-premium, Rajnish Mehra and Edward C. Prescott (1985) find that the historical return on stocks has been too high in relation to the return on risk-free assets to be explained by the standard economic models of risk and return without invoking unreasonably high levels of risk aversion. What is even more, studies of the differences in a risk premium between the countries in the world seem to be completely neglected.

The equity risk premium is a forward looking concept since it should reflect the future risk assuming investing today in a risky asset. However, a commonly applied approach by researchers for estimating the future ERP is the historical equity risk premium approach. Pablo Fernández (2010) by observation of 150 books on corporate finance and valuation from the most famous, as well as less known authors, found that their recommendations as to what risk premium is ranged between 3% to 10%, confirming their confusion about it. Additionally, in 51 books he discovered that the authors recommend different risk premiums on a different page in the book. Most of them assume equality between the expected and historical risk premium in the way that the average (arithmetic or geometric) realized risk premium in the past is the basis for its estimation in the future. Elroy Dimson, Paul Marsh, and Mike Staunton (2003) call the difference between the *ex-post* equity returns and the risk-free rate *excess returns*. In fact, they argue that these differences depict the realized excess returns and should not be equal with the equity risk premium because it is misleading. Namely, the realized excess returns may vary from year to year and at certain times are negative. Therefore, according to Dimson, Marsh, and Staunton (2003), it would be absurd to assume that investors would require a negative return for investing in equity. Thus, as Fernández (2013) stated, “many authors assume equality between historical ERP and expected ERP, although these two concepts are completely different”. Actually, many authors consider that the equity premium is a stationary process, and HEP is an unbiased estimate of the EEP (unconditional mean equity premium). He gives a clear distinction between the four concepts: historical, expected, required and implied equity risk premium (HEP, EEP, REP and IEP), for which today many authors assume that HEP = EEP = REP. Fernández (2013) furthermore abandons the Mehra and Prescott (2003) statement that over the long horizon the equity premium is likely to be similar to what it has been in the past, arguing that HEP is not a good estimator of the EEP.

Making decisions for the future requires application of *ex-ante*, i.e. the expected risk premium. Estimates of the expected ERP based on the analyses of historical excess returns time series assume that the historical data provide adequate direction for future expected long-term behavior. In other words, using past results to draw inferences about expectations depends in some measure on an assumption of rational expectations. But the historical equity risk premium varies over time, and consequently, it is unclear why data from a distant past can be useful for predicting the expected returns and the EEP. Furthermore, rational expectations are often inaccurate (e.g. Raj Aggarwal, Sunil Mohanty, and Frank Song 1995). Fernández (2013) and many other authors emphasize that the historical equity risk premium is not a good estimator of expected equity risk premium. Moreover, in the case of a small and open emerging country, with a short history and volatile equity market, the historical approach seems senseless to be used.

Hence, the proper estimation of the expected risk premium for a particular country firstly requires knowledge of its nature and its national characteristics as determinants. An estimate of the expected ERP in less developed and emerging markets is much more complicated than in developed countries. Exploring the extensive literature in this area, it can be concluded that the empirical research of this significant number, *ex-ante* risk premia, in emerging markets is scarce. Most of the research on equity risk premium is focused on the US equity market and other industrialized countries, and there is a small amount of research on non-US *ex-ante* equity premia or on their determinants in a global setting. However, emerging markets in recent decades are of growing importance. They are advancing and attracting investors from the US and other developed countries.

To understand the expected risk premium in emerging markets we must first point out that emerging markets differ significantly from developed markets. Overall, emerging markets are less developed; have a lower quality of governance; a higher country credit risk; show more mutual synchronous market movement, as reported by Randall Merck, Bernard Yeung, and Wayne Yu (2000), Nikola Gradojević and Eldin Dobardžić (2013); are exposed to contagion risk, as argued by Kuan-Min Wang and Hung-Cheng Lai (2013); are facing illiquidity, shown by Boško Živković and Jelena Minović (2010); and have a smaller influence of individual stock characteristics. They also have higher market concentration with small samples of firms accounting for large proportions of aggregate market values, in the structure of financial intermediation dominating the banking sector, unlike the US where financial markets have dominance in the financial architecture. A most recent study by Aleksandar Naumoski et al. (2017) investigated the linkages of six SEE emerging marets in three analyzed periods: the pre-crisis, mid-crisis, and post-crisis period. They found that the relationships of the SEE markets with the developed markets, and among them, are not stable in the long-run. But in the same study, authors found stable and long-run relationship and inter-linkages among the developed markets.

Unlike the developed markets, which are rational and efficient, developing markets and emerging markets are less perfect. Hence, to be able to understand the national equity risk premium, what is needed is a good understanding of how these market imperfections (market inefficiencies) affect both equity returns and the risk-free rate. National expected ERP, i.e. the compensation for the risk of investing in shares as a risky asset, is influenced by the overall balance between costs and benefits of investing in stocks. Here, the non-pecuniary determinants are of great importance. Roger G. Ibbotson, Jeffrey J. Diermeier, and Laurence B. Siegel (2006) also suggest the demand for equity returns is not under the influence only from the risk factors, but there is great influence by numerous non-pecuniary benefits and costs. Ibbotson, Diermeier, and Siegel (2006) in their *New Equilibrium Theory* suggest that investors view all assets as "bundles of characteristics", whereas the price of risk assets depends not only on quantitative items (e.g. stock-market beta risk, interest-rate risk, inflation risk and a size risk) but also on many non-pecuniary determinats that enhance the desirability of holding equity (e.g. tunneling and/or control premia). Non-pecuniary benefits of equity ownership are often discussed in terms of private benefits of control. "The private benefits of control" are defined by Craig Doidge (2004) as the ability of majority shareholders to exploit insufficient legal protections to extract value out of firms at the expense of minority shareholders. He uses the "voting premium" as a proxy for private benefits of control. As a measure of the private benefits of control, Alexander Dyck and Luigi Zingales (2004) use the "block premium", and Michael J. Barclay, Clifford G. Holderness, and Jeffrey Pontiff (1993) use the percent of managerial stock ownership.

As has been stated above, the view that the equity risk premia is generally accepted as a difference between the expected return on equity and the risk-free rate is the price of the risk in equity investment that should compensate the risk averse investros for assuming risk. Therefore, it is logical to expect that this *ex-ante* risk premium will vary between countries. Firstly, among the countries there is a vast difference in the size of the risk due to national characteristics and other macroeconomic factors. Secondly, in different countries there is a difference in the way of pricing the risk, i.e. the valuation of risk assessment. It seems that the latter is crucial. Namely, as the equity premium is the price of equity risk, it is determined by the balance between supply and demand for equity returns. Therefore, to properly assess the equity risk premium in emerging markets, the nature of supply and demand for shares, should ultimately be taken into consideration since the emerging stock markets are inefficient and imperfect. For an inefficient market the price can not be properly dimensioned as in the case of efficient markets. Ibbotson, Diermeier, and Siegel (2006) suggest that because of many obstacles and limitations, the supply and demand for equity in markets may not respond to market forces as would be expected from a theoretical view of efficient markets.

Aggarwal and John W. Goodell (2008) state that "in order to understand the nature of equity premia in emerging markets, it is important to note that, because of many obstacles and limitations, the supply and demand for equity in emerging markets may not respond to market forces as they do in developed economies. For example, the supply of equity may be restricted, as bureaucratic rules and regulations may deter the formation and market listing of corporate shares. Similarly, due to uncertain property rights and the unreliability of public information on potential investments, the demand for equity may also be limited". Further, in their following paper Aggarwal and Goodell (2011) strongly suggest that "the demand for equity returns is likely to be influenced by a great variety of factors that influence the risk level of equity and society's perceptions, tolerance and appetite for equity risk. The nature of legal protection for investors, disclosure requirements, the level of social trust that a particular society believes can be placed on strangers, and the political stability of a country certainly are some additional factors that come to mind. Similarly, it is also reasonable that many social, cultural, legal and governance characteristics of a country might also affect the demand for equity".

Thus, in the Republic of Macedonia, according to law provisions almost all companies are forced to be listed in the Stock Exchange, even those where 99% of the equity capital is owned by one owner. This has a significant impact on the distortion of the supply, whereby a slight increase or decrease in demand for the outstanding shares from these companies from the "mandatory listing"[1] causes large changes in stock prices on a daily basis. On the other hand, in order to prevent excessive daily turbulence in prices, the stock exchange has imposed daily maximum and minimum limits of fluctuations of stock prices relative to the average price from the previous day of ±10% for the shares traded in the regime of continuous trading, and ±20% for stock trading at auctions. All of this is only part of the bureaucratic and legal restrictions that violate the concept of an efficient market and thus equity risk premium develops quite different dimensions compared to developed countries. Market determination of ERP in the precise size in such conditions seems absurd.

Therefore, any attempts to derive an estimation of the expected equity risk premium based on the use of market equity returns, including their linkage to the national characteristics of the country (as in Aggarwal and Goodell 2008, 2011), with the macroeconomic factors (as in Dilip K. Patro, John K. Wald, and Yangru Wu 2002; Goodness C. Aye, Frederick W. Deale, and Rangan Gupta 2016; and many others), in the case of a small and open emerging country, with a short history and volatile equity market, with imposed restrictions, bureaucratic rules and regulations seem senseless to be applied. Hence, it appears that the survey approach is very suitable for the estimation of the ERP in emerging countries. In this approach, the relevant class of investors, managers and academics know best, on average, to assess the stock market and the real price of risk, taking into account all the elements together, starting from the nature of supply and demand, national characteristics, financial architecture,

[1] From January 2013 Macedonian stock exchange introduced "mandatory listing" and in this segment are listed companies that do not qualify for the regular market. Those are the companies at which at least 1% of shares are distributed to the public and has at least 50 shareholders. The price limitations apply for all listings.

macroeconomic variables, and everything else. If the risk premium is what investors expect today as a compensation for the risk assumed for investing in risky assets, then the most logical approach to estimate this size seems to be in asking these investors what their expected return is on the stock market portfolio above the risk-free rate in the next period. As John Y. Campbell (2008) states: "What return should investors expect the stock market to deliver, above the interest rate on a safe short-term investment? In other words, what is a reasonable estimate of the equity premium?"

2. Literature Review

Research on the estimation of equity risk premium in emerging markets is rare. Most of the research is focused on the US equity market, and relatively little attention is paid to the estimation of equity risk premium in other developed industrialized countries, such as the developed countries of Western Europe, Japan, Australia, etc. Furthermore, research is largely based on the explanation of the historical risk premium, although ERP is a forward looking concept. Research on differences in equity risk premium between different countries has been totally neglected. In this section we will mostly look at studies of *ex-ante* equity risk premium in emerging markets. But given that the survey approach is almost not applied in the case of emerging markets, we will make a more extensive review of this approach in the case of the United States as the best example.

2.1 The Equity Risk Premium in Emerging Markets and Its Determinants

Research on equity risk premium in emerging markets can be segmented to those which explore: (i) determinants of cross-national variations in equity premia; (ii) determinants of the *ex-ante* cost (returns) of equity capital; (iii) determinants of the *ex-post* equity premia; (iv) determinants of the *ex-ante* equity premia; and (v) survey approach for estimating the ERP. In this part (2.1) research for the first four points will be shown, while the next part (2.2) will be devoted to the survey approach, since this paper is based on that approach.

Dev R. Mishra and Thomas J. O'Brien (2005) assess the relationship between estimated risk measures and the *ex-ante* cost of equity estimates in a sample of 16 emerging market equities for the period 1990-2000. They concluded that the measure of total risk is the most significant risk factor in explaining *ex-ante* expected return estimates, especially for the emerging market equities with substantial invest ability to global investors, where global beta appears to add some explanatory power. Previusly, Campbell R. Harvey (2000) had concluded the same, while working with mean realized returns and indexes of 28 emerging markets. Yet, this is consistent with the evidence in Geert Bekaert and Harvey (1997), where they also concluded that many emerging markets appear to be impacted by total risk measures like variance and skewness. Harvey (2004) further examines the importance of political risk, financial risk, and economic risk in portfolio and direct investment decisions. Here, he found that the country risk measures are correlated with the future equity returns, but only in emerging markets. In addition, there are many other authors that clearly confirm the relationship between the credit risk with both the equity risk premia and the equity returns.

Thus, Tobias Berg and Christoph Kaserer (2010) model estimates of equity premia from credit-default swap (CDS) spreads; Naumoski (2012) provides estimation of the ERP in the case of the Republic of Macedonia from the estimated country risk premium (CRP) where the CRP was derived from the country's credit ratuing; Harjoat S. Bhamra, Lars-Alexander Kuehn, and Ilya A. Strebulaev (2010) model credit risk within a model of asset pricing, so as to price equity and debt within the same framework. Luzi Hail and Christian Leuz (2006) do not focus directly on the *ex-ante* equity premium but on the *ex-ante* cost of equity, which when reduced by the risk-free rate gives the ERP. Using a sample of 40 countries, they analyzed whether the effectiveness of a country's legal institutions and securities regulation is systematically related to cross-country differences in the cost of equity capital. They concluded that firms from countries with more extensive disclosure requirements, stronger securities regulation and stricter enforcement mechanisms have a significantly lower cost of capital.

Roelof Salomons and Henk Grootveld (2003) and later on, Joshua D. Shackman (2006) provided an empirical view of the *ex-post* equity risk premium (the excess returns) in a number of international markets, with special attention to emerging ones using a sufficiently long time period. Both of them came to the same findings, that is, emerging markets have higher excess returns (HEP) than developed markets. But, Shackman (2006) found that when adjusted for risk, developed markets have higher returns. From Shackman (2006) we can see that for the same period and for the same countries, the final results are completely different, and they even move in totally opposite directions depending on the approach used in the analysis. Namely, Salomons and Grootveld (2003) use a US money-market rate as the risk-free rate and price equity returns in US dollars. Is this right, or should the local numbers be used? Shackman (2006) follows two alternative methodologies: the first is the same as Salomons and Grootveld (2003), with expressions in $US and US risk-free rate, and the second, local treasuries for the risk-free rates and pricing in local currency. He came completely opposite results, for example, using the first methodology Brazil has a positive excess return of 25.42%, and with the second methodology Brazil's investors realized a negative −20.37%. It is from here that we can see one more reason why the HEP approach is not appropriate to be used for estimating the ERP of emerging markets, besides the other reasons stated above.

S. Nuri Erbas and Abbas Mirakhor (2007) explore the sources of equity premium using some pertinent fundamental independent variables, as well as the World Bank institutional quality indexes and other proxies for the degree of ambiguity on the sample of 53 emerging and mature markets. They found that a large part of equity premium may reflect investor aversion to ambiguities resulting from institutional weaknesses. Besides Erbas and Mirakhor (2007), there have been other authors trying to explain the ERP in the emerging markets using country-specific variables and macroeconomic variables. Patro, Wald, and Wu (2002) uses country-specific macroeconomic and financial variables (including imports, exports, inflation, government surplus, credit ratings, taxes, money supply, market capitalization as a fraction of GDP, market capitalization as a fraction of world capitalization, dividend yield, term spread, price-to-book ratio, and earnings-to-price ratio) with a panel approach for explaining risk-adjusted excess returns. They find that a smaller, but significant portion of the risk-adjusted excess returns are related to the macroeconomic and financial variables.

Aggarwal and Goodell (2008) provide research on the nature of *ex-ante* equity premia for a sample of 16 emerging markets, using data for an 8-year period. They made an estimation of the *ex-ante* annual equity premia based on earnings forecasts and their findings indicate that, with a mean (median) of 3.13 (1.27%), emerging market equity premia are quite low, especially as comparedto the risk-free rates that have a mean (median) of 11.08 (8.30%). Actually they show that in spite of the generally higher risk and uncertainty in emerging markets, *ex-ante* equity premia in many emerging markets are surprisingly low. In addition, based on a panel-data regression analysis, they proved that, for emerging markets, equity premia narrow with higher market synchronicity, higher economic inequality and better civil liberties, while equity premia widen with better regulatory quality and investor protection and greater international corporate bond spreads. Their findings suggest the possibility that in many emerging markets there are non-pecuniary benefits to holding equity or that controlling ownerships have preferential access to capital, which is what Ibbotson, Diermeier, and Siegel (2006) posit in the *New Equilibrium Theory*.

In a more recent paper, Aggarwal and Goodell (2011) try to explain the role of the financial intermediation and the financial architecture as an explanatory variable of the national ERP. They investigate the endogenous relationship between financing architecture and *ex-ante* equity risk premia by using simultaneous equations estimates that include financial architecture as an instrumental variable along with a number of other relevant institutional, governance, and cultural factors. Specifically, they examined the nature of international variations in national *ex-ante* equity premia with a special emphasis on exploring the role of financial architecture. They use the data from an 8-year period, 1996-2003, from 33 countries, most of them being emerging markets. They concluded that equity premia are larger in countries that have a more bank-oriented financial architecture, that are wealthier, and that have better governance, i.e. with greater control of corruption and better regulatory quality. Actually, the emerging markets are not only those that have more bank-oriented architecture, but also more of the developed countries, like Japan and Germany, are bank-oriented, while other countries, like the Anglo-Saxon countries (e.g. the US, UK, Canada, Australia) depend more on financial markets.

2.2 Survey Approach in Estimating Equity Risk Premium in Emerging Markets

Investors are heterogeneous in terms of information they hold, the level of risk aversion, their expectations, and incentives for investment. The survey of a relevant class of investors, professionals, academics and managers allows to see the current mood in the representative or average investor and to estimate the expected equity risk premium for the market as a whole. Indeed, Dimson, Marsh, and Staunton (2003) themselves draw suspicion for using past results under the unreal assumption of rational expectation to draw inferences about expectations as surveys, such as Ivo Welch (2000), of estimates of the equity premia that seem to vary extensively with short-term market fluctuations. Here, Aggarwal and Goodell (2008) emphasize that the applicability of research on excess returns for this research on *ex-ante* equity premia based on an earnings model might be inappropriate.

There is little research that applies the survey approach for estimating the expected ERP in the case of emerging markets. Prof. Publo Fernandes from *IESE Business School* continuously provides an estimation encompassing countries from all over the world and emerging markets among them (e.g. Fernández, Javier Aguirreamalloa, and Pablo Linares 2013). Most of the other research of this type is focused on the US. Therefore, that research based on the US case is used as the best studied example, which we take as the guidance to provide a similar research in the case of the Republic of Macedonia, as a benchmark for a small emerging market that shares the common characteristics with other emerging markets in Southest Europe and beyond. Here we will look at some significant and mostly cited works.

Welch (2000) conducted two surveys of professors of finance in 1997 and 1998, asking them what thought would be the expected equity risk premium for the next 30 years in the US. He received 226 responses, which range from 1% to 15%, the arithmetic average of 7% over the long-term government bonds rate of 6%. Welch (2001) presented results from a survey of 510 professors of economics and finance, conducted in August 2001, and the consensus for the 30-year expected risk premium was 5.5%, which was much lower than three years before. Welch (2009) shows that the market risk premium “applied” by professors of finance was on average 5.89%, while 90% of the professors applied a premium between 4% and 8.5%.

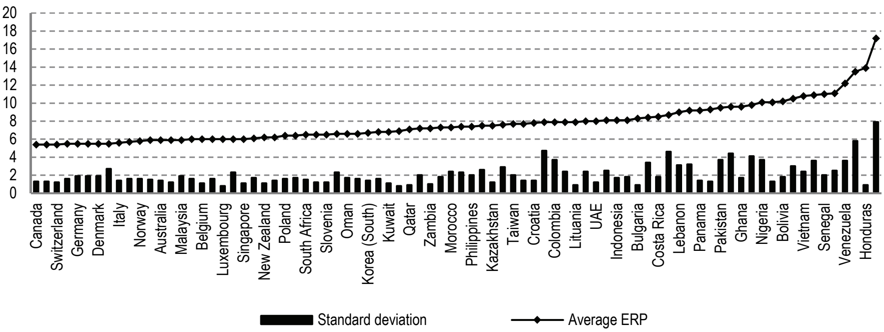
John R. Graham and Harvey (2005) show that financial executives in the US reduced their average EEP from 4.65% in September 2000 to 2.93% in September 2005. Jim O’Neill, Rumi Masih, and Dominic Wilson (2002) conducted a survey of their global customers in July 2002, and the estimated average long-term EEP amounted to 3.9%, with most of the responses being between 3.5% and 4.5%. The magazine Pensions and Investment (on 01. December, 1998) conducted a survey among professionals working within institutional investors and the estimated average EEP was 3%. The Securities Industry Association (SIA) continuously conducted surveys from 1999 to 2004. In the last survey in 2004 they examined 1.500 investors in the US and found that the median return was 12.8%, which gives a risk premium of 8.3% above the rate of return on long-term government bonds. In the previous years, they found that the average expected return by investors was 10% in 2003, 13% in 2002, 19% in 2001, 33% in 2000, and 30% in 1999.

In a monthly report of the survey of institutional investors in the US from February 2007, Merrill Lynch showed an average expected equity risk premium of 3.5%, which increased to 4.1% in March 2008, after the fall of the market. After the markets calmed down in 2009, the expected risk premium once again returned to a level of 3.76% in January 2010. Until March 2010 the risk premium remained in the range of 3.85% to 3.90%, but the premium increased to 4.08% in January 2012.

Don T. Johnson, Thomas P. Kochanek, and Jeremy M. Alexander (2007) present the results of a survey of 116 professors in North America from March 2007: 90% of the professors believe that EEP in the next 30 years will stay in the range between 3% and 7%.

Fernández, Aguirreamalloa, and Luis Corres Avendano (2011a, b), in a survey with 5.731 answers, provide a comparison of the size and the standard deviation of the estimated risk premium for the US in the three categories of participants: professors (average ERP 5.7%, SD 1.6%), analysts (average ERP 5.0%, SD 1.1%) and companies (average ERP 5.6%, SD 2%). Fernández, Aguirreamalloa, and Linares (2013) provide statistics of the Risk-Free Rate and of the Equity Premium or Market Risk Premium (MRP) used in 2013 for 51 countries.

Fernández, Aguirreamalloa, and Isabel Fernández Acín (2015) have conducted one of the most comprehensive world surveys for ERP. In May and June 2012 they sent 21.500 e-mails to professors of finance and economics, analysts and managers of companies. They provided 7.192 relevant responses from 82 countries for the required market risk premium in 2012. The results are presented in Figure 1. The lowest is the ERP in Canada of 5.4%, and the highest in Iran of 17.2%. In fact, ERP is low on the left half of the graph, which depicts the developed countries, becoming higher and more volatile on the right half of the graph, which depicts the underdeveloped countries and emerging countries, which is actually an understandable risk - return trade off.



Source: According to data published in Fernández, Aguirreamalloa, and Acín (2015).

Figure 1 Market Risk Premium (in %) Used in 82 Countries in 2012

Professors John R. Graham and Campbell R. Harvey from Duke University in the United States, starting from the third quarter of 1996 to the present, continuously conduct surveys of US Chief Financial Officers (CFOs). Graham and Harvey (2013) have summarized the data showing the ERP for the period between June 2000 and December 2012. They show that expectations of US CFOs in December 2012 are that the return of the stock market in the US in the first quarter of 2013 will be 5.46%, which compared to the yield of the 10-year government bond rate taken as a risk-free of 1.63% gives an ERP of 3.83%, which is slightly higher than the overall 12-year average ERP of 3.53%. The highest ERP was in February 2009 of 4.78%. The analyzed period covers two crises: March 2001-September 2001, and the recent global financial crisis: December 2007-June 2009. Overall, they show that the risk premium is not constant over time as it is assumed by the classical financial paradigm, but varies over time, and financial theory links that with the influence of the business cycles. In fact, the simple economic logic suggests that the risk premiums should be highest during recession, when the risk of investment in shares increases, and declines during economic prosperity, when investors' optimism increases. According to Graham and Harvey (2013), during the recession the expected market risk premium was 3.98%, and during stable economic activity it was 3.42%. In fact, for the entire analyzed period the expected average premium is 3.53%, indicating that the expected risk premium is high in the non-recessive period as well. In fact, it is still a result of expectations for market growth, and as Aswath Damodaran (2013) states, in forming their expectations the subjects are biased and also their expectations are under the influence of the events in the most recent past. Additionally, in the recessive period the increase of the standard deviation of the risk premium is evident, suggesting that people have less confidence in their predictions. But while in the post-recessive period the EEP decreases, the standard deviation remains high.

3. Estimating the Expected Equity Risk Premium in the Republic of Macedonia

In this section we analyze the results of the survey of the expectations for the stock market in the Republic of Macedonia, a small and open European emerging economy, with a short and very volatile history of the stock market. The estimation is provided for the end of the year 2013 and for the next 10 years. We polled professors, analysts and managers for their expectations of the value of the Macedonian Stock Exchange Index MBI10 in the future. We derived the ERP indirectly. Namely, based on these expectations we calculate the market return, and given the current yield on the three-month government treasuries and 10-year government Eurobond used as a risk-free rate, we estimate the expected risk premium in the short-term and long-term respectively. We also present the measures of descriptive statistics.

3.1 Method

3.1.1 Design

On March 04, 2013 we sent a survey to a very carefully selected group of professors, analysts, investors, managers, and professionals in the field of capital market in the Republic of Macedonia. The survey was conducted electronically, and the subjects interviewed were sent a link to an anonymous survey *via* e-mail. Appendix A provides an overview of the survey (Survey on Expected Value of MBI10 Index 2013)[2].

Folowing Graham and Harvey (2013), the survey contained two key questions. The first asked polled subjects to provide a short-term forecast, and was stated as such: "At the end of 2013, I expect that the value of MBI10 will be: ...". The second question asked the respondents to provide a long-term forecast, and stated: "After 10 years, I expect that the value of MBI10 will be: ...". Moreover, in both cases the respondents were asked to express their expectations about the value of MBI10 in three scenarios: lower value (for which there is a 1-in-10 chance that the actual value will be less than), most likely value, and higher expected value (for which there is a 1-in-10 chance the actual value will be greater than). The third question asked them to indicate which are at the company they work in belongs to.

[2] **Survey on Expected Value of MBI10 Index.** 2013. https://docs.google.com/forms/d/1HsZATbRYuJQ-I8SbUQ4yLXkMwdy2itwEZJYBwfzTfvY/edit#.

Our target group were University professors in finance and economics, CFOs, chief accounting officers, treasurers, portfolio managers, analysts, fund managers, stockbrokers, and bankers in the area of corporate lending; risk managers in banks, insurance companies; managers in insurance companies; journalists writing on issues in economics and business in various media and a sample of individual investors.

The survey was sent to 145 subjects, out of whom 77 responded, which represent 53.1%, and this can essentially be considered a very high response. They were given four working days to respond to the survey. The majority of responses were received on the first day.

3.1.2 Data Integrity

In order not to provide any suggestions in regards to the answers, there wasn't given any additional information or data so as to challenge only those who know the stock market very well and the overall current and expected macroeconomic situation in the Republic of Macedonia and the events and movements in the world economy. Only the following introduction was given to specifically explain what was required from the surveyed subjects: "As at 28.12.2012 - the last trading day of the year - the value MBI10 index was 1,731.2. Please give your short-term and long-term forecasts for the future value of the MBI10 index". In spite of these instructions, we received extremes in the responses.

Thus, some explained that the value of the index would be 1,000, which is actually the value of its initial level of the MBI10 index on its introduction on January 01, 2005. Others expressed over-optimistic amounts, while there are some who expected that the value of the index would reach 20,000 or even 30,000. The MBI10 index reached its historic maximum before the beginning of the global financial crisis on August 31, 2007 of 10,057.77. Both responses are considered to be unrealistically optimistic and pessimistic expectations, especially since the same subjects at the same time had given a very low lowest-value and extremely high highest-value, where the most likely value is somewhere in the middle between the lowest and the highest expected value (e.g. the same subject expected that the value of the MBI10 index would range from 1,500 lowest value, 15,000 most likely to 30,000 the highest value). Such responses only contribute to excessive standard deviation and thus to less confidence in the estimated size. Therefore, according to the approach used in Graham and Harvey (2013), those answers that were considered unrealistic were eliminated: over-optimistic and over-pessimistic expectations, responses with excessive range values (e.g. 1,500 to 30,000), and so-called "lazy answers", where the three values had been given the same amounts in the three scenarios. Finally, this led to the deletion of 4 responses in both questions and the assessment was carried out with the remaining 73 observations.

3.1.3 Methodology

The estimation of expected equity risk premium is derived indirectly. We were convinced that in a very young stock market, the concept of the equity risk premium is not well-known. Therefore, the polled subjects were asked to express their expectations about the value of the MBI10 index after one year and after ten years. For each value they were asked to express their forecasts in threes cenarios: scenario 1 - the low value (for which there is a 1-in-10 chance the actual value will be less than); scenario 2 - the most likely value; and scenario 3 - the high expected value (for which there is a 1-in-10 chance the actual value will be greater than). Cosequently, we obtained six pieces of data, the three for the short-term forecast: (1) the 1-year most likely forecasts (MST); (2) lower 10% of 1-year forecasts (LST); (3) higher 10% of the 1-year forecast (HST); and accordingly three for the long-term forecast; (4) the 10-year most likely forecast (MLT); (5) lower 10% of the 10-year forecast (LLT); and (6) higher 10% of the 10-year forecast (HLT).

Accordingly, the series is comprised of the expected values of the index in future time t (t = 1 and 10) for each scenario s (s = 1,2,3), i.e. it is $MBI10_{t.s}$. Thus, the expected value of the index after one year for the scenario s is $MBI10_{1.s}$, and the expected value of the index in the scenario s after ten years is $MBI10_{10.s}$. Based on the expected values we initially calculated the annual return in each scenario s(1,2,3).

The expected annual return E($R_{1,s}$) in the short-term forecast, in each scenario s(1,2,3) is calculated as:

$$E(R_{1,s}) = \frac{E(MBI10_{1,s}) - MBI10}{MBI10} \bullet 100. \quad (1)$$

Here, E($MBI10_{1,s}$) is the expected value of the index MBI10 after one year in the scenario s, and MBI10 is the value of the index of 1,731.2 on the last trading day of the last year (December 28, 2012).

The expected annual return for the long-term forecast, for each scenario is defined as the average annual growth rate of the index value, using a geometric growth rate:

$$E(R_{10,s}) = \left(\sqrt[n-1]{\frac{E(MBI10_{10,s})}{MBI10}} - 1 \right) \bullet 100. \quad (2)$$

Here, E($R_{10,s}$) is the expected annual stock-market return for scenario s(1,2,3) in the long-term forecast (average annual growth rate of the index value). E($MBI10_{10,s}$) is the expected value of the index after 10 years in the scenario s, and $MBI10$ is the value of the index on the last trading day of the preceding year (December 28, 2012).

Given that in any observations there are three scenarios and three expected values of the MBI10 index - lower, most probable, and higher expected value - the expected return for observation i that is E(R_i) must consider the expected return in every scenario s for observation i that is E($R_{s,i}$) with the corresponding probability $P_{(s)i}$ in each scenario s. To solve this problem, we refer to the Donald L. Keefer and Samuel E. Bodily (1983) paper, where they compare a number of approximations used to estimate means and variances of continuous random variables and/or to serve as substitutes for the probability distributions of such variables, with particular emphasis on three-point approximations. Keefer and Bodily (1983) preferred a method of estimating the variance of a probability distribution of random variables, given information about the 10th and 90th percentiles, is the simple approximation of the L. B. Davidson and D. O. Cooper (1976). According to Davidson and Cooper (1976), estimating the mean and variance of each variable can be developed from three values that describe the range of uncertainty for each variable. In our case those are the three values: (a) the lower value, *L*, small enough so there is only about a 10% chance of encountering a smaller value; (b) the most-likely value, *M*; and (c) the higher value, *H*, large enough so there is only about a 10% chance of exceeding it. With information on the 10% tails, we construct a probability distribution for each respondent. We use Davidson and Cooper's (1976) method to recover each respondent's probability distribution.

The expected return $E(R_i)$ for every observation *i*, derived from the three scenarios *s*(1,2,3) for observation *i*, is estimated from these values using the formula:

$$E(R_i) = \frac{x\,(0.10) + 2x_m + x\,(0.90)}{4}, \quad (3)$$

where, $E(R_i)$ is the expected return for every observation *i*, derived from the three scenarios *s*(1,2,3); $x(0.90)$ and $x(0.10)$ represent the 90th and 10th percentiles of the respondent's distribution, HST (or HLT) and LST (or LLT) respectively, and x_m is the most-likely value MST (or MLT); LST (or LLT) is the lower value: expected annual return $E(R_{1,1})$ in the short-term forecast, or the expected annual return $E(R_{10,1})$ for the long-term forecast; MST (or MLT) is the most-likely value: expected annual return $E(R_{1,2})$ in the short-term forecast, or the expected annual return $E(R_{10,2})$ for the long-term forecast; HST (or HLT) is the higher value: expected annual return $E(R_{1,3})$ in the short-term forecast, or the expected annual return $E(R_{10,3})$ for the long-term forecast.

Davidson and Cooper (1976) also proposed an approximation using the 0.10 and 0.90 fractiles for the estimation of the individual variance, σ^2, using the formula:

$$\text{Variance} = \sigma^2 = ([x(0.90) - x(0.10)] / 2.65)^2, \quad (4)$$

where, $x(0.90)$ and $x(0.10)$ represent the 90th and 10th percentiles of the respondent's distribution, HST (or HLT) and LST (or LLT).

Equations (3) and (4) are accurate to within about 10 percent of the range ($x(0.90) - x(0.10)$) for most distribution shapes that exhibit central tendency and no additional information about distribution shape is needed to be used. Equation (4) shows that over a wide range of distribution shapes (normal, beta, triangular, etc.), the 80% confidence-interval range ($x(0.90) - x(0.10)$) has a "width" equal to 2.65 standard deviations. This is slightly higher than the value of 2.56 for the normal distribution. Equations (3) and (4) are sufficiently accurate except for extremely skewed distributions. Therefore, in the next step we will estimate the skewness and asymmetry of the distribution using the formula proposed by Graham and Harvey (2013), as folows:

$$Asymmetry = \frac{\{[x(0.90) - x_m] - [x_m - x(0.10)]\}^3}{\sigma^3}. \quad (5)$$

Finally, the expected equity risk premium for the observed response *i* is the expected incremental return over the risk-free rate of return:

$$E(ERP_i) = E(R_i) - R_f. \quad (6)$$

Here, $E(ERP_i)$ is the expected equity risk premium for the observed response *i*, and R_f is the current risk-free rate.

According to Davidson and Cooper (1976), the simple average of the individual $E(ERP_i)$ will be the forcasted figure as a unique ERP for the market.

The simple approximation of Davidson and Cooper (1976) can be a good property. Since we are not completely satisfied with it, we are going one step further and we are going to introduce the most appropriate statistical distribution to be fitted to the data. Using that distribution, we will estimate the ERP. Over the last several centuries, numerous probability distributions have been developed to address the data analysis and a number of statistical methods exist to assist in selecting the best fitting distribution. After fitting some distributions to our data we need to determine the most valid model. We will select the best fitted distribution using the most popular *goodness-of-fit-tests*, including three of the most used: Kolmogorov-Smirnov, Anderson-Darling, and Chi-squared tests.

With the goodness-of-fit tests, we measure the "distance" between the data and the distribution we are testing (called the **test statistic**), and compare that distance to some threshold value (called the critical value). If the **test statistic** is less than the critical value, the fit is considered good. The logic of applying various goodness-of-fit tests is the same, however, they differ in how the test statistics and critical values are calculated. The test statistics are usually defined as some function of sample data and the theoretical (fitted) cumulative distribution function. The critical values depend on the sample size and the significance level chosen. The significance level is the probability of rejecting a fitted distribution (as if it was a bad fit) when it is actually a good fit. The significance level that we are using is $\alpha = 0.05$. Since the goodness-of-fit test statistics indicate the distance between the data and the fitted distributions, it is obvious that the distribution with the lowest statistic value is the best fitting model.

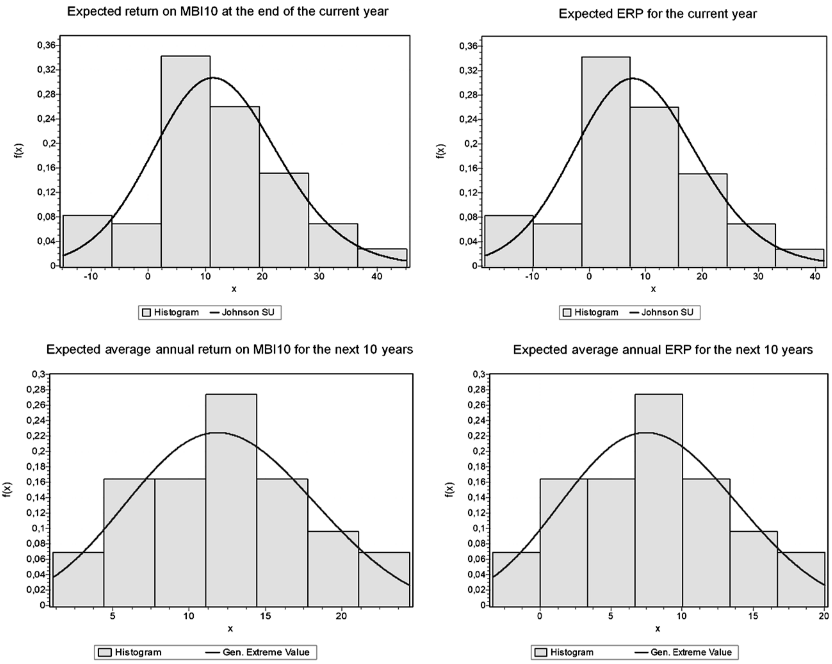
4. Estimation Results

By applying (3), first we calculate the data for returns expected by every individual. Next, by applying (6) we derive the risk premiums for each individual. Here, as a risk-free rate for computing the short-term risk premium we take the current yield on the three-month government bond, which is 3.65%, and for the long-term ERP forecast, we use the 10-year governement eurobond yield, which is 4.4%. The long-term Macedonian Governement Eurobond is trading on the London Stock Exchange. The data for the current yield is taken from the Thomson Reuters Datastream. The data for the short-term treasury yield is taken from the website of the Ministry of Finance of the Republic of Macedonia (2013).

Table 1 Estimations of the Parameters of the Distributions

	Short-term forecasts		Long-term forecasts	
	Expected return on MBI10 at the end of the current year	Expected ERP for the current year	Expected average annual return on MBI10 for the next 10 years	Expected average annual ERP for the next 10 years
Probability distribution	Johnson's SU	Johnson's SU	Generalized extreme value	Generalized extreme value
Parameters	γ=-0.67596 δ=3.5358 λ=38.63 ξ=4.4681	γ=-0.67596 δ=3.5358 λ=38.63 ξ=0.81816	k=-0.27328 σ=5.6802 μ=5.719	k=-0.27328 σ=5.6802 μ=10.119

Source: Authors' estimation.



Source: Authors' estimation.

Figure 2 Probability Density Function

In the next step, for the obtained data on expected returns and ERP it is necessary to find out the distribution that fits most. We examine 61 theoretical distribution and implement *goodness-of-fit* tests to select the best fitting distribution for our data. By applying the Kolmogorov-Smirnov test at the significance level of 0.05, we found that the best fitted distribution for the short-term expected returns and short-term ERP is Johnson's SU distribution. Using the same test, we found that for the long-term expected returns and long-term ERP, the best fitted distribution is generalized extreme value (GEV) distribution. The general properties of these two distributions are presented in Appendix B and the goodness-of-fit summary is presented in Appendix C. In Table 1 we demonstrate the estimation of the parameters that result from fitting the theoretical statistical distributions described in Appendix B applied to the series of our data, and in Figure 2 we present their probability density functions.

Finally, in Table 2 the results of the analysis are presented. Academics and practitioners together have expected return on the MBI10 index of 12.2% for the current year. The expected long-term average annual return of the MBI10 index is 12.16%. We estimated the expected ERP for the current year to be 8.55%, which is slightly higher than the estimated expected average annual ERP for the next 10 years of 7.76%. With the estimated expected returns that are almost the same, the differences in the expected ERP came from the risk-free rate.

Table 2 Summary Statistics of the Expected Market Risk Premium in the Republic of Macedonia Based on the Survey Approach

	Short-term forecasts		Long-term forecasts	
	Expected return on MBI10 at the end of the current year	Expected ERP for the current year	Expected average annual return on MBI10 for the next 10 years	Expected average annual ERP for the next 10 years
Probability distribution	Johnson's SU	Johnson's SU	Generalized extreme value	Generalized extreme value
Mean	12.20	8.55	12.16	7.76
Mode	/	/	11.86	7.46
Minimum	-INF	-INF	-INF	-INF
Maximum	+INF	+INF	30.90	26.50
Disagreement (standard deviations of estimates)	11.59	11.59	5.70	5.70
Average of individual standard deviations	10.80	10.80	2.71	2.71
Average of individuals' worst 10% market return scenario	-1.90	-5.55	8.41	4.01
Average of individuals' best 10% market return scenario	26.72	23.07	15.59	11.19
Skewness	0.0521	0.0521	0.0135	0.0135
Average of individuals' asymmetry	-0.24	-0.24	-0.30	-0.30
Kurtosis	0.4028	0.4028	-0.2801	-0.2801
No. of responses	73	73	73	73

Source: Authors' estimation.

Although returns and risk premiums are approximately the same in the short- and long-term, the deviations are however significantly different. We calculate the standard deviation as a measure of risk, which is also taken as a measure of disagreement of the subjects regarding the forecasted size. The standard deviation of the short-term forecast is twice as high as the long-term.

We also report information on the average of assessments of the 1-in-10 chance that the market will exceed or fall below a certain level. The worst case total return is -1.9% in the short-term (8.41% in the long-term). The best case return in the short-term is 26.72%, much greater than that of the long-term of 15.59%.

With information on the 10% tails, we construct a probability distribution for each respondent. Using the Davidson and Cooper (1976) method we recover each respondent's probability distribution. The average of individual volatilities is used as an individual disagreement. In the short-run the average of individual standard deviations is 10.8%, and is very high compared to the long-term figure of 2.71%. This second figure is very close to the developed countries, e.g. in the US 3.84% for the same period, according to Graham and Harvey (2013). There is also a natural measure of asymmetry in each respondent's response. Using the Equation (5) we estimated the individual assymetry, whose average of the ERP is -0.24 in the short-term and -0.3 on the long-term.

4.1 Results Using Other Goodness-of-Fit Tests

It may be noted that the Anderson-Darling test, which is the refinement of the Kolmogorov-Smirnov test, weighs the fit to the tails more and is generally considered to be more powerful than the original Kolmogorov-Smirnov test, therefore many analysts prefer it. The Chi-squared tests weighs the overall fit more. In Tables 3 and 4 we present results using these two other tests. It can be noted that the Anderson-Darling and Chi-squared test identify other best distribution fits than Kolmogorov-Smirnov test, but the expected results are almost the same.

Table 3 Results Using Anderson-Darling Test

	Short-term forecasts		**Long-term forecasts**	
	Expected return on MBI10 at the end of the current year	Expected ERP for the current year	Expected average annual return on MBI10 for the next 10 years	Expected average annual ERP for the next 10 years
Probability distribution fit	Dagum 4P	Dagum 4P	Generalized extreme value	Generalized extreme value
Mean	12,24	8,65	12,16	7,76
Mode	11,27	7,39	11,86	7,46
St. dev.	11,70	/	5,70	5,70
Skewness	0,2569	/	0,0135	0,0135
Kurtosis	1,1834	$-2{,}6556 \cdot 10^{14}$	-0,2801	-0,2801

Source: Authors' estimation.

Table 4 Results Using Chi-Squared Test

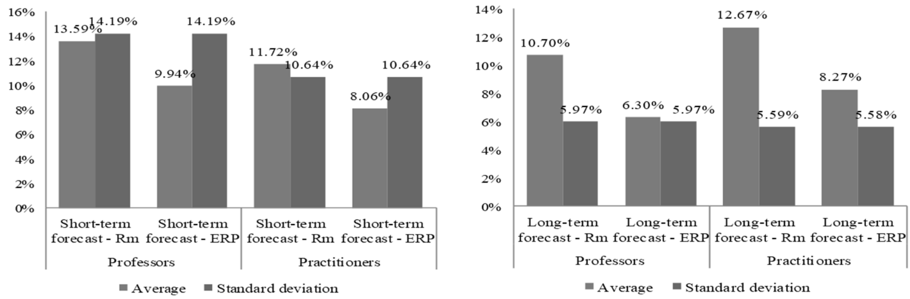
	Short-term forecasts		**Long-term forecasts**	
	Expected return on MBI10 at the end of the current year	Expected ERP for the current year	Expected average annual return on MBI10 for the next 10 years	Expected average annual ERP for the next 10 years
Probability distribution fit	Generalized extreme value	Generalized extreme value	Normal	Normal
Mean	12,20	8,55	12,16	7,76
Mode	10,67	7,02	12,16	7,76
St. dev.	11,48	11,48	5,63	5,63
Skewness	0,1576	0,16	0	0
Kurtosis	-0,2082	-0,20821	0	0

Source: Authors' estimation.

4.2 Difference between the Academics and Practitioners

The analysis below shows the differences in expectations between the two classes of participants: professors and practitioners. We use the same probability distributions for the short- and long-term estimation. Figure 3 depicts the results.

In the short-term, it is obvious that the academics are more optimistic than the practitioners. Professors expect that the return on the MBI10 index will be 13.59%, which is above the average of the whole number of respondents (of 12.2%), where as the practitioners have lower expectations and believe the MBI10 index will grow by 7.72%, which is far less than the entire average. However, the degree of disagreement with forecasted growth measured by the standard deviation is also higher among the professors. The same conclusions are in terms of the expected risk premium. Namely, the professors expect higher compensation for the risk undertaken in the short-term of 9.94%, compared to only 8.06% for the practitioners.



Source: Authors' estimation.

Figure 3 Short-Term and Long-Term Forecasts of the Professors and Practitioners

Long-term forecasts are reversed. Practitioners are more optimistic and expect an average annual growth of 12.67% of the MBI10 index, compared with 10.7% by the professors. The average expected long-run return of entire respondents is 12.16%. Moreover, the practitioners expect greater compensation for the risk undertaken of 8.27%, compared to 6.3% for the professors. The standard deviation is similar in both groups of respondents, which is two and three times lower than the short-term forecast.

5. Conclusion

Equity risk premium is the price of risk that should compensate risk averse investors for assuming the risk of investing in equity as a risky asset instead of investing in risk-free assets. This number is a curtail parameter in corporate finance and assets pricing. Investors, corporate managers, money managers and academics needs a proper estimation of this number in order to make a right long-term financial decision. The ERP is a forward looking concept since it should reflect the future risk assumed investing today in a risky asset, but mostly it is identified with the historical excess returns, which is completely misleading. Therefore, here we discuss the *ex-ante* ERP or the expected ERP as that is what is needed. The estimation of the *ex-ante* ERP is difficult in most developed and mature equity markets with a long history, but is even harder in the young, small and open emerging markets economies, as are the post-communist countries in Southeast Europe. Unlike the developed markets, which are rational and efficient, developing markets and emerging markets are less perfect. Actually, there are bureaucratic and legal restrictions that violate the concept of an efficient market and thus equity risk premium develops quite different dimensions compared to developed countries. To be able to understand the national equity risk premium in emerging markets, what is needed is a good understanding of how these market imperfections (market inefficiencies) affect both equity returns and the risk-free rate. This paper address those issues and provides an estimation of the expected ERP for the Republic of Macedonia, a small and open emerging market that shares the same characteristics as other South European emerging markets.

Moreover, in the last five years the markets return on the Macedonian Stock Exchange is negative, the historical realized annual average ERP is positive and amounts to 11.66% (Naumoski 2012). It is obvious that in a young market, with a short and volatile history, the historical realized returns are not enough for predicting the future. In our paper, we estimated the ERP using a survey of academics and practitioners. We derived the expected ERP indirectly by asking the polled subject for their expectations about the value of the stock market index MBI10. This is because we thought that most of the subjects do not understand the concept of ERP. Their answers allowed us to calculate the expected market return and ERP. Afterwards, we performed a Kolmogorov-Smirnov goodness-of-fit test and determined that the best fitted statistical distributions are the Johansns' SU for the short-term and the general extreme value for the long-term ERP. Based on those models, we estimated the expected ERP of 8.55 for the end of the current year, and the expected average annual ERP for the next 10 years of 7.76. Compared with the other studies for different countries these numbers are similar with other emerging markets in the world and pretty much higher than the developed markets. This typically depicts the risk-return relationship, which exists in investors' perceptions for emerging markets as more risky markets, which requires a higher compensation for the risk undertaken.

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Appendix A

Excerpt from the Survey Instrument

Survey on expected value of MBI10 Index

As at December 28, 2012, the last trading day of the year, the value of of MBI10 Index was 1,731.2. Please give your short-term and long-term expectations for the future value of MBI10 Index.

Short-term expectation

1. At the end of 2013, I expect that the value of MBI10 Index will be:

Lower value (there is a 1-in-10 chance the actual value will be less than):

Most probable value

Higher value (there is a 1-in-10 chance the actual value will be greater than):

NEXT

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Survey on expected value of MBI10 Index

Long-term expectations.

2. After 10 years, I expect that the value of MBI10 Index will be:

Lower value (there is a 1-in-10 chance the actual value will be less than):

Most probable value

Higher value (there is a 1-in-10 chance the actual value will be greater than):

3. In which sector belongs the company at which you work?
- Banking / Insurance
- Stockbroker Agency / Investment Fund / Pension Fund
- Other financial intermediaries
- Telecommunications
- Energetics
- Technology [software etc.]
- Health / Pharmacy
- Wholesale / Retail
- Construction
- Manufacturing
- Communications / Media
- Consultancy
- University Professor / Teaching Assistant of Finance / Economics
- Other:

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Appendix B

Dagum (Inverse Burr) Distribution. For the random variable x: $\gamma \leq x < \infty$, the probability density function (pdf) of Dagum 4-parameters (4p) distribution is given as:

$$f\ (x) = \frac{\alpha k \left(\frac{x-\gamma}{\beta}\right)^{\alpha k-1}}{\beta\left(1+\left(\frac{x-\gamma}{\beta}\right)^{\alpha}\right)^{k+1}},$$

k, $\alpha > 0$ are the two shape parameters,
$\beta > 0$ is the scale parmeter,
γ is the location parameter ($\gamma \equiv 0$ yields the three-parameter Dagum distribution).

Generalized Extreme Value (GEV) Distribution. For the random variable x:

$$1 + k\frac{(x-\mu)}{\sigma} > 0 \qquad \text{for } k \neq 0$$
$$-\infty < x < +\infty \text{ for } k = 0,$$

the probability density function of generalized extreme value distribution is given as:

$$f\ (x) = \begin{cases} \frac{1}{\sigma}\exp\left(-(1+kz)^{-1/k}\right)(1+kz)^{-1-1/k} & k \neq 0 \\ \frac{1}{\sigma}\exp\left(-z-\exp(-z)\right) & k = 0 \end{cases}$$

k - shape parameter,
σ - scale parameter ($\sigma > 0$),
μ - location parameter.

Johnson SU Distribution. For the random variable x: $-\infty < x < +\infty$, the probability density function (pdf) of Johnson SU distribution is given as:

$$f\ (x) = \frac{\delta}{\lambda\sqrt{2\pi}\sqrt{z^2+1}}\exp\left(-\frac{1}{2}\left(\gamma + \delta\ln\left(z+\sqrt{z^2+1}\right)\right)^2\right),$$

where

$$z \equiv \frac{x-\xi}{\lambda}$$

γ - shape parameter,
δ - shape parameter ($\delta > 0$),
λ - scale parameter ($\lambda > 0$),
ξ - location parameter.

Normal Distribution. For the random variable x: $-\infty < x < +\infty$, the probability density function (pdf) of the normal distribution is given as:

$$f\ (x) = \frac{\exp\left(-\frac{1}{2}\left(\frac{x-\ \mu}{\delta}\right)^2\right)}{\sigma\sqrt{2\pi}},$$

σ - scale parameter ($\sigma > 0$),
μ - location parameter.

Appendix C

Summary of the Goodness-of-Fit Test for the Short-Term Forecast

Method: Kolmogorov-Smirnov

α	0.05
Critical value	0.15649
Sample size	73

Rank	Expected return on MBI10 at the end of the current year		Expected ERP for the current year	
	Distribution	Statistic	Distribution	Statistic
1	Johnson SU	0.05399	Johnson SU	0.05399
2	Fatigue life (3P)	0.05828	Burr (4P)	0.05401
3	Lognormal (3P)	0.05851	Dagum (4P)	0.05574
4	Beta	0.05866	Pearson 5 (3P)	0.05734
5	Dagum (4P)	0.05933	Erlang (3P)	0.05793
6	Gen. gamma (4P)	0.05986	Lognormal (3P)	0.05818
7	Inv. gaussian (3P)	0.06020	Fatigue life (3P)	0.05828
8	Gen. extreme value	0.06034	Gen. gamma (4P)	0.05856
9	Gamma (3P)	0.06041	Gamma (3P)	0.05917
10	Pearson 5 (3P)	0.06052	Beta	0.05976
11	Log-logistic (3P)	0.06072	Inv. gaussian (3P)	0.06020
12	Normal	0.06117	Gen. extreme value	0.06034
13	Burr (4P)	0.06291	Log-logistic (3P)	0.06072
14	Error	0.06391	Normal	0.06117
15	Erlang (3P)	0.06899	Error	0.06391
16	Logistic	0.07145	Logistic	0.07145
17	Kumaraswamy	0.07177	Weibull (3P)	0.07181
18	Weibull (3P)	0.07181	Kumaraswamy	0.07217
19	Chi-squared (2P)	0.07614	Chi-squared (2P)	0.07614
20	Hypersecant	0.08616	Hypersecant	0.08616
21	Cauchy	0.08751	Cauchy	0.08751
22	Gumbel max	0.09259	Gumbel max	0.09259
23	Frechet (3P)	0.09354	Frechet (3P)	0.09292
24	Triangular	0.09504	Gen. pareto	0.10083
25	Gen. pareto	0.10083	Pert	0.10260
26	Pert	0.10260	Uniform	0.11027
27	Uniform	0.11027	Pearson 6 (4P)	0.11316
28	Laplace	0.11356	Laplace	0.11356
29	Gumbel min	0.12217	Gumbel min	0.12217
30	Rayleigh (2P)	0.15503	Triangular	0.13129
31	Pearson 6 (4P)	0.15641	Rayleigh (2P)	0.15503
32	Power function	0.23281	Power function	0.23281
33	Exponential (2P)	0.33655	Error function	0.31957
34	Error function	0.44252	Exponential (2P)	0.33655
35	Levy (2P)	0.44817	Levy (2P)	0.44817
36	Student's *t*	0.77936	Student's *t*	0.65276
37	Burr	No fit	Burr	No fit
38	Chi-squared	No fit	Chi-squared	No fit
39	Dagum	No fit	Dagum	No fit
40	Erlang	No fit	Erlang	No fit
41	Exponential	No fit	Exponential	No fit
42	Fatigue life	No fit	Fatigue life	No fit
43	Frechet	No fit	Frechet	No fit
44	Gamma	No fit	Gamma	No fit
45	Gen. gamma	No fit	Gen. gamma	No fit
46	Inv. gaussian	No fit	Inv. gaussian	No fit
47	Johnson SB	No fit	Johnson SB	No fit
48	Levy	No fit	Levy	No fit

49	Log-gamma	No fit	Log-gamma	No fit
50	Log-logistic	No fit	Log-logistic	No fit
51	Log-pearson 3	No fit	Log-Pearson 3	No fit
52	Lognormal	No fit	Lognormal	No fit
53	Nakagami	No fit	Nakagami	No fit
54	Pareto	No fit	Pareto	No fit
55	Pareto 2	No fit	Pareto 2	No fit
56	Pearson 5	No fit	Pearson 5	No fit
57	Pearson 6	No fit	Pearson 6	No fit
58	Rayleigh	No fit	Rayleigh	No fit
59	Reciprocal	No fit	Reciprocal	No fit
60	Rice	No fit	Rice	No fit
61	Weibull	No fit	Weibull	No fit

Source: Authors' estimation.

Summary of the Goodness-of-Fit Test for the Long-Term Forecast

Method: Kolmogorov-Smirnov

α	0.05
Critical value	0.15649
Sample size	73

Rank	Expected average annual return on MBI10 for the next 10 years		Expected average annual ERP for the next 10 years	
	Distribution	**Statistic**	**Distribution**	**Statistic**
1	Gen. extreme value	0.04136	Gen. extreme value	0.04136
2	Pert	0.04625	Pert	0.04625
3	Johnson SB	0.04674	Johnson SB	0.04674
4	Triangular	0.04694	Normal	0.04971
5	Normal	0.04971	Inv. gaussian (3P)	0.04982
6	Weibull (3P)	0.05001	Burr (4P)	0.04994
7	Inv. gaussian (3P)	0.05002	Weibull (3P)	0.05001
8	Burr (4P)	0.05025	Triangular	0.05176
9	Error	0.05302	Fatigue life (3P)	0.05266
10	Fatigue life (3P)	0.05355	Error	0.05302
11	Lognormal (3P)	0.05377	Erlang (3P)	0.05340
12	Gamma (3P)	0.05590	Lognormal (3P)	0.05349
13	Pearson 6 (4P)	0.05592	Pearson 6 (4P)	0.05439
14	Pearson 5 (3P)	0.05748	Gamma (3P)	0.05558
15	Erlang (3P)	0.05832	Pearson 5 (3P)	0.05611
16	Log-logistic (3P)	0.06096	Log-logistic (3P)	0.06096
17	Dagum (4P)	0.06215	Gen. gamma (4P)	0.06240
18	Gen. gamma (4P)	0.06240	Kumaraswamy	0.06400
19	Dagum	0.06350	Beta	0.06498
20	Beta	0.06498	Logistic	0.07187
21	Log-pearson 3	0.06541	Dagum (4P)	0.07253
22	Burr	0.06956	Gen. pareto	0.07729
23	Logistic	0.07187	Uniform	0.07883
24	Gen. pareto	0.07729	Hypersecant	0.08641
25	Uniform	0.07883	Frechet (3P)	0.09367
26	Rice	0.08443	Gumbel max	0.09690
27	Hypersecant	0.08641	Cauchy	0.09979
28	Rayleigh	0.08698	Rayleigh (2P)	0.09986
29	Nakagami	0.08770	Gumbel min	0.10412
30	Gamma	0.09217	Laplace	0.10484
31	Frechet (3P)	0.09379	Chi-squared (2P)	0.10726
32	Gumbel max	0.09690	Power function	0.13305
33	Weibull	0.09771	Exponential (2P)	0.24835
34	Cauchy	0.09979	Levy (2P)	0.40761
35	Rayleigh (2P)	0.09986	Error function	0.53092

36	Chi-squared	0.10365	Student's *t*	0.75269
37	Gumbel min	0.10412	Burr	No fit
38	Laplace	0.10484	Chi-squared	No fit
39	Chi-squared (2P)	0.10726	Dagum	No fit
40	Inv. gaussian	0.11572	Erlang	No fit
41	Gen. gamma	0.11750	Exponential	No fit
42	Pearson 6	0.12511	Fatigue life	No fit
43	Kumaraswamy	0.13069	Frechet	No fit
44	Power function	0.13305	Gamma	No fit
45	Lognormal	0.14532	Gen. gamma	No fit
46	Log-logistic	0.15384	Inv. gaussian	No fit
47	Log-gamma	0.18038	Johnson SU	No fit
48	Fatigue life	0.19271	Levy	No fit
49	Pearson 5	0.21121	Log-gamma	No fit
50	Erlang	0.22329	Log-logistic	No fit
51	Frechet	0.22800	Log-pearson 3	No fit
52	Pareto 2	0.24682	Lognormal	No fit
53	Exponential (2P)	0.24835	Nakagami	No fit
54	Exponential	0.26116	Pareto	No fit
55	Pareto	0.39455	Pareto 2	No fit
56	Levy (2P)	0.40761	Pearson 5	No fit
57	Reciprocal	0.41545	Pearson 6	No fit
58	Levy	0.43077	Rayleigh	No fit
59	Error function	0.71808	Reciprocal	No fit
60	Student's *t*	0.90988	Rice	No fit
61	Johnson SU	No fit	Weibull	No fit

Source: Authors' estimation.

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