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THE IMPACT OF LIQUIDITY AND SIZE PREMIUM ON EQUITY PRICE FORMATION IN SERBIA***

ABSTRACT: *The goal of this paper is to examine the impact of an overall market factor, the factor related to the firm size, the factor related to the ratio of book to market value of companies, and the factor of liquidity risk on expected asset returns in the Serbian market. For this market we estimated different factor models: Capital Asset Pricing Model (CAPM by Sharpe, 1964), Fama-French (FF) model (1992, 1993), Liquidity-augmented CAPM (LCAPM) by Liu (2006), and combination LCAPM with FF factors. We used daily data for the period from 2005 to 2009. Using a demanding methodology and complex dataset, we found that liquidity and firm size had a significant impact on equity price formation in Serbia. On the other hand, our results suggest that the factor related to the ratio of book to market value of companies does not have an important role in asset pricing in Serbia. We found that Liu's two-factor LCAPM model performs better in explaining stock returns than the standard CAPM and the Fama-French three-factor model. Additionally, Liu's LCAPM may indeed be a good tool for realistic assessment of the expected asset returns. The combination of the Fama-French model and the LCAPM could improve the understanding of equilibrium in the Serbian equity market. Even though previous papers have mostly dealt with examining different factor models of developed or emerging markets worldwide, none of them has tested factor models on the countries of former Yugoslavia. This paper is the first to test the FF model and LCAPM with FF factors in the case of Serbia and the area of ex-Yugoslavia.*

KEY WORDS: *CAPM, Fama-French model, Liu's LCAPM, Liquidity, Zero Rates.*

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1. INTRODUCTION

The Serbian market is undeveloped, illiquid, and in transition. Factors that have the most significant influence on market illiquidity are few stocks with considerable capitalization, scarce shares outstanding, and infrequent and irregular trading. In addition there are typically short time series of past trades, a lack of transparency and of readily accessible information about traded companies, and the appearance of the so-called invisible forms of risk (Latković & Barac, 1999). Šoškić & Živković (2007) pointed out that in transition economies such as the Serbian, the required financial structure that would enable accelerated economic development has not been achieved. Some of the missing elements are state regulation, corporate control, private financial analysis, financial intermediation, etc. Further disadvantages of the Serbian market include the lack of transparency reports and state regulation, short history of trading, conspicuous asymmetry, and unreliability of information. For example, there are no exact rules regarding available information about companies, and consequently insider information has a huge influence on investors' decisions. Better regulation in this area, with an increased amount of publicly available information, can reduce the information asymmetry risk. At the same time this would decrease transactional costs and reduce illiquidity risk, thus raising the level of foreign investment. These undeveloped financial markets present a modelling challenge and require the creation of new models (Minović & Živković, 2010).

The Standard Capital Asset Pricing Model (CAPM by Sharpe, 1964, and Lintner, 1965) is a one-period, static model with one factor, namely, market risk. This model represents the equilibrium relationship between market risk and expected return on liquid markets. In this model the portfolio (assets) risk-premium is proportional to the market risk premium, with a beta coefficient of proportionality. The premium for a market portfolio represents the expected excess return over the risk-free rate that a particular investor expects to get in order to decide on investing in the market portfolio (Urošević, 2008), (Minović & Živković, 2010).

Fama & French (1992) showed that CAPM does not perform very well even for developed markets. The pros and cons of CAPM are presented in Campbell, Lo, & MacKinlay (1997). They propose including additional risk factors in the model. In order to explain stock returns in the U.S. market, Fama & French (1993) identify three common risk factors: an overall market factor (the excess market return), the factor related to firm size, and the factor related to the ratio of book to market value of companies. Fama & French's results (1992, 1993) significantly improve the performance of the model compared to the single-factor model (Minović & Živković, 2010). Fama & French (1996) pointed out that their model cannot explain all asset returns in different markets, and they advise conducting research based on another model for other factors. Liu (2004, 2006) analysed the two-factor model (market risk and liquidity risk) versus the Fama-French model. His two-factor model, Liquidity-augmented CAPM (LCAPM), has greater power in explaining returns than Fama-French's three-factor model.

Zhang (2010) pointed out that emerging markets often feature low liquidity and infrequent trading. He explained that investors in emerging markets were attracted by the high return potential, but at the same time were scared by the liquidity risk in the market. Yeyati, Schmukler & Van Horen (2008) described the behaviour of liquidity in emerging markets during periods of crisis. These authors[1] found that in times of crisis markets continue to operate even in small and unstable emerging economies. Rouwenhorst (1999) analysed returns and liquidity in 20 emerging markets. Bekaert & Harvey (2002, 2003) analysed different emerging markets. Clark (2008) examined the history and measurement of liquidity risk in emerging markets. Cajueiroa & Tabak (2004) also analysed emerging markets. They have shown that in time these markets become efficient. Zhang (2010) elaborated that emerging markets have more insider trading and weaker corporate governance compared to the US market. He said that investors, especially retail investors, feared that they could be expropriated by the management or more informed investors. Zhang (2010) pointed out that investors also had relatively low disposable income to invest in the stock market and limited resources to obtain information. He said that all

[1] These authors analysed the most liquid stocks in different emerging markets.

these factors resulted in the on-average low trading activity in emerging markets (Minović, 2011). Živković & Minović (2010) explored illiquidity and its volatile behaviour in the Serbian financial market. These authors showed that foreign investors had an active interest in the Serbian market before the global economic crisis. However, its small size and poor liquidity are the main factors impeding interest in this market. Živković & Minović (2010) proved that, in most cases, the cause of dramatic falls and rises in market illiquidity and of increases in liquidity risk lies in the growth and fall of foreign investors' participation.

One of the key problems facing the small Serbian market is the low level of liquidity. Recent literature pays more attention to liquidity risk. Many studies argue that investors require higher expected returns (size, growth, and liquidity premium) as compensation for continuing to invest in small companies with high book-to-market ratio and illiquidity of stocks. This is because these stocks are all associated with higher investment risk. Therefore in order to perform a more realistic assessment of expected asset returns in the Serbian equity market it is necessary to introduce additional factors that measure liquidity risk, company size, and the ratio of book to market value of companies.

In this paper we present the results of testing different factor models on the Serbian stock market. Specifically, in order to explain that in an undeveloped market investors require different premiums as compensation for exposing themselves to different risks, we considered different CAPM extensions. These models are: the Fama-French (FF) model, Liu's LCAPM, and LCAPM+FF. We used data from the Belgrade Stock Exchange - BELEX - for the period from October 14, 2005 to December 31, 2009. Since the global economic crisis happened within this estimation period, the changes in the economic environment reflected on the value of the parameters in the regression models. These models are estimated for two separated sub-periods, pre- and during-crisis. Risk factors that primarily affect the formation of equity prices in the Serbian market are isolated. To measure illiquidity, we chose zero rate return measurement as given by Lesmond, Ogden & Trzcinka (1999). We examined the impact of an overall market factor, factor related to firm size, factor related to the ratio of book to market value of companies, and the factor of liquidity risk on expected asset returns on the Serbian market. We used the Ordinary Least Squares (OLS) method in regression analysis in order to estimate different factor models. Various robustness checks were performed. We found that the factor of liquidity risk was statistically significant, and it improved significantly the explaining power of expected asset returns. Our results in this paper are similar to the results obtained by Hearn et al. (2009), Rahim & Nor (2006), Halliwell et al. (1999), Sadka (2006), Chai et al. (2011), and Amihud et al. (2005). We found that Liu's two-factor LCAPM model performs better in explaining stock returns than the CAPM and the Fama-French three-factor models. On the other hand, the superiority of LCAPM tells us that high liquidity risk (the high level of illiquidity) distorts the basic mechanism of price discovery in the Serbian equity market. Consequently, it is impossible to establish equilibrium in the long term in this market.

The hypotheses set up for this research are:

1. Liquidity and firm size have significant impact on price formation in Serbia.
2. Standard CAPM has to be augmented by the factor of liquidity risk in order to achieve equilibrium in undeveloped markets. This makes for the new class of Liquidity CAPM (LCAPM).

Thus in this paper we will indicate which of the existing factor models for developed markets are most convenient for describing the equilibrium in Serbia as a frontier market. Additionally, this is the first paper that examines the application of the FF model and LCAPM with FF factors in the case of Serbia.

The paper is structured as follows: Section 2 presents a literature review; Section 3 presents the Fama-French model, Liu's model, and zero rate illiquidity measurement; Section 4 presents the estimation methodology and the discussion of constraints related to data and variables; Section 5 discusses the results of the estimation of different factor models and explores the impact of an overall market factor, the factor related to firm size, the factor related to the ratio of book to market value of companies, and the factor of liquidity risk on expected asset returns in the Serbian equity market; Section 6 presents our conclusions.

2. LITERATURE REVIEW

In the existing literature the authors who have tested different factor models focused their attention mainly on developed markets, such as the U.S. market and the European market, or on emerging markets in Asia, Africa, and South America. Additionally, in his website[2] Kenneth French often updates the research data for Fama-French factors, but mainly for North American, Japanese, and European markets. The testing of models using ready-made factors for developed markets is, therefore, greatly simplified: quite the opposite to what is required for examining factor models in emerging and frontier markets, where Fama-French factors are almost non-existent and data for their formation often publicly unavailable, while the available data are inadequate and of questionable quality.

Rahim & Nor (2006) clearly document that the market factor alone cannot capture other risks in stocks in the Malaysian market. The implication for investment is that, instead of relying merely on the market factor, investors must also be concerned with firm-specific factors such as distress and liquidity levels, particularly in this equity market. They pointed out that investors require additional premiums to compensate for risk due to distress and illiquidity, rather than just to compensate for risk due to small size. Rationally, small size in itself does not make a company riskier. Rather, it is the company's risk of being in distress and the risk of losing liquidity that drive investors to seek higher than market-risk premiums (Rahim & Nor, 2006). Liquidity is an important risk factor, which has motivated many authors to research it. Amihud, Mendelson & Pedersen (2005) reviwed the literature that studies the relationship between liquidity and asset prices. They showed, theoretically and empirically, that liquidity had wide-ranging effects on financial markets. Haugen (2002) tested the Fama-French model with American data for the period 1979-1999. He observed that, in the long run, value stocks have better performance than growth stocks. Shum & Tang (2005) examined the application of Fama & French's (1993) three-factor model in three Asian emerging markets (Hong Kong, Singapore, and Taiwan). Their results are consistent with Haugen's

2 http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

(2002) results in showing that this model can explain most of the variations in average returns. However, Shum & Tang (2005) found that the main contributing factor is the contemporary market excess return. Chan & Faff (2003) examined the role of liquidity in asset pricing, and Chai, Faff & Gharghori (2011) examined liquidity impact on stock returns, in the context of a Fama-French cross-sectional framework for the Australian equities market. Chai et al. (2011) found a significant illiquidity premium and they showed that liquidity explained a portion of the common variation in stock returns even after controlling for size, book-to-market, and momentum. However, their findings suggested that the liquidity factor only added marginal explanatory power to contemporary asset pricing models. Halliwell, Heaney & Sawicki (1999) and Gaunt (2004) tested the Fama-French model with Australian data. Halliwell et al. (1999) showed that the factor related to firm size was statistically significant, while the factor related to the ratio of book to market value of companies does not exist for the Australian market. They inferred that the role of the factor related to the ratio of book to market value of companies is not important for the explanation of asset returns. Sadka (2006) also showed that the factor related to the ratio of book to market value of companies was not statistically significant. Gaunt (2004) proved that the Fama-French model has greater power in explaining returns than the standard CAPM. Contrary to the previous authors, he showed that the factor related to the ratio of book to market value of companies has a significant role in asset pricing.

Bundoo (2006) examined the Fama-French model for the African emerging market. He showed that the Fama-French model is adequate for this market. Additionally, Bundoo's (2006) results showed that the Fama-French model with time-varying beta coefficient is specified adequately. Liu (2004, 2006) and Martínez et al. (2005) investigated liquidity risk effects on stock returns in the American and the Spanish stock exchange, respectively. Tam (2007) examined standard CAPM, the Fama-French model, and Liu's LCAPM in the British stock market. He showed that the Fama-French model could not improve standard CAPM, because of two factors (firm size and the ratio of book to market value) that are too weak to provide sufficient explaining power. He proved that the factor of firm size was irrelevant for expected returns. Tam (2007) showed that the ratio of book to market value was a statistically significant factor, but not the firm size factor. He showed a low negative relation between the ratio of book to market value factor and the expected return. He inferred that the liquidity factor in Liu's (2006) LCAPM is statistically significant, and that it improves the explaining power of expected returns significantly. Thus, he proved that Liu's LCAPM is the most superior of all the analysed models. Hearn, Piesse & Strange (2009) examined the roles of company size and illiquidity in asset pricing in the context of the Fama-French cross-sectional framework in emerging African financial markets (South Africa, Kenya, Egypt, and Morocco). Hearn et al. (2009) showed that both factors, company size and illiquidity, were statistically significant. However, in the African market firm size is a more dominant factor than liquidity risk. Hearn (2010) examined the performance of CAPM augmented by size and liquidity factors with its time-varying coefficient in the markets of India, Pakistan, Bangladesh, and Sri Lanka. His results suggest that substantial size and liquidity effects are present in all markets, with the sole exception of Sri Lanka. Hearn (2010) concluded that time-varying liquidity beta profiles reveal the effects of the 2008 financial crisis on the financial sectors of all South Asian markets, with the exception of Sri Lanka, whose market is under the influence of a prolonged civil war. Lieksnis (2011) analysed cross-sectional returns of the stocks in the Baltic stock market (Latvia, Estonia, and Lithuania). He used monthly returns on stocks for the period 2002-2010, applying the methodology presented in Fama & French (1996). Lieksnis (2011) showed that the Fama-French model could explain asset returns in the Baltic stock market. Lischewski & Voronkova (2012) investigated the relevance of the market, size, book-to-market, and liquidity factors in the Polish market. They analyzed the standard CAPM, the Fama–French three-factor model, and LCAPM (Fama-French model augmented by mimicking portfolio for illiquidity factor). These authors found that small stocks outperform large stocks, and value stocks outperform growth stocks. Lischewski & Voronkova (2012) showed that in the Polish stock market the small value stocks show the highest return, while the large growth stocks show the lowest return. They found evidence that the market factor, size, and book-to-market value factors all have explanatory power for the Polish stock returns. Lischewski & Voronkova (2012) concluded that liquidity risk is less relevant for the Polish stock market. Minović & Živković

(2010) examined the impact of illiquidity and time-varying liquidity risks on expected asset returns in the Serbian stock market using the conditional LCAPM of Acharya & Pedersen (2005). As the measure of illiquidity they used the price impact measure suggested by Bekaert et al. (2007). Minović & Živković (2010) showed that, for the Serbian market, illiquidity and liquidity risks significantly affect price formation. They showed that illiquidity is persistent on the Serbian stock market. Furthermore, illiquidity commoves with contemporary returns. Minović & Živković (2010) showed that one of the liquidity risk factors (beta4) dominates other risk factors as to its impact. Their results suggest that the proposed model (LCAPM by Acharya & Pedersen, 2005) fits rather well with the Serbian stock market data.

There is no evidence in the existing literature to date of any research testing factor models (FF, and LCAPM plus FF factors) in the countries of former Yugoslavia (especially in Serbia). Consequently, there are no pointers as to which of the available factor models (CAPM, FF, LCAPM or LCAPM+FF) used in efficient and developed markets could be most conveniently applied to describe the equilibrium in these undeveloped countries, especially in Serbia. This paper contributes to this field of research.

3. FACTOR MODELS AND ILLIQUIDITY MEASURE

3.1. Fama-French model

Fama & French (1992, 1993) constructed a three-factor model. They identified three common risk factors: overall market factor (the excess market return), factor related to firm size (SMB factor), and factor (HML factor) related to the ratio of book to market value (B/M) of companies.

They inferred that risks have to be multivariate in rational assessment of stocks. Fama & French (1992) found that the HML factor (in relation to B/M ratio) has stronger impact on average stock returns than the SMB factor related to firm size. The firms with high value of B/M (relatively small stock size versus book value) tend to have low earnings. By contrast, low value of B/M (relatively big stock size versus book value) relates to persistent high earnings (Fama & French, 1993).

The three-factor Fama-French model (CAPM+FF) reads:

$$E\left(R_t^i - R_t^f\right) = \beta^i\left[E\left(R_t^M - R_t^f\right)\right] + \lambda_{SMB}E\left(SMB_t\right) + \lambda_{HML}E\left(HML_t\right) \quad (1)$$

$$\text{with } \beta^i = \frac{\operatorname{cov}\left(R_t^i, R_t^M\right)}{\operatorname{var}\left(R_t^M\right)}. \quad (2)$$

Here, $E\left(R_t^i\right)$ is the expected return of security/portfolio *i* and $E\left(R_t^M\right)$ is the market. R_f is the risk free rate, the risk premium is $E\left(R_t^m - R_t^f\right)$, the systematic undiversifiable risk is β^i. Fama & French formed their factor in the following way: first, according to the value of their market capitalization, they classified stocks as small and big (50:50). Then, they classified them according to the value of book-to-market ratio into small and big stock groups. They classified stocks as value, neutral, and growth (30:40:30) according to the value of their B/M ratio. SMB (Small Minus Big) is the average return on three small portfolios, minus the average return on three big portfolios. HML (High Minus Low) is the average return on two-value (the high value of B/M) portfolios, minus the average return on two-growth (the low value of B/M) portfolios. $E\left(SMB_t\right)$ is the expected value of firm size factor, $E\left(HML_t\right)$ is the expected value related to the ratio of book to market value of companies, λ_{SMB} and λ_{HML} are premiums related to these two factors.

3.2. Liu's model (Liquidity-augmented CAPM, LCAPM)

Liu (2004, 2006) constructed a two-factor model based on CAPM plus the factor IML that captures liquidity risk. The two-factor model implies that the expected excess return of an asset is explained by the covariance of its return with the market and the liquidity factors (Liu, 2006). The expected excess returns of security/portfolio *i* from the two-factor model read (Liu, 2006):

$$E\left(R_i\right) - R_f = \beta_{M,i}\left[E\left(R_M\right) - R_f\right] + \lambda_{IML}E\left(IML\right) \quad (3)$$

where $E\left(R_t^M\right)$ is the expected return of the market portfolio, and $E(IML)$ is the expected value of the liquidity factor (Liu, 2006). Liu (2004) and Manzler (2005) classified stocks according to their illiquidity, and then formed two decile portfolios, the low-liquidity and the high-liquidity portfolios. Therefore the IML (Illiquid Minus Liquid) factor is the average return on one illiquid portfolio, minus the average return on one liquid portfolio.

Tam (2007) pointed out the two drawbacks of Liu's (2006) LCAPM: the big difference in results depending on the measure of (il)liquidity used, and the lack of sufficient empirical testing and evidence to support this model.

3.3. The Zero-Return Measure (LOT's measure)

Lesmond, Ogden & Trzcinka (1999) proposed an illiquidity measurement based on the portion of zero return days out of possible trading days. The zero-return measure is the ratio of the number of zero-return days and the total number of trading days in a given month (Lee, 2006). LOT's measure (or ZR measure) is defined as follows:

$$ZR_{i,t} \equiv \frac{N_{i,t}}{T_t}, \tag{4}$$

where T_t is the number of trading days in a month t and $N_{i,t}$ is the number of zero-return days of stock i in a month t.

The economic intuition for zero return measure is derived from the simple trade-offs of the cost and benefit of trading for informed investors: when the trading cost is too high to cover the benefit from informed trading, informed investors choose not to trade and this non-trading leads to a conspicuous zero return for that day. More importantly, zero-return measure is defined over zero-volume days, as well as positive volume days, since this measurement assumes that a zero-return day with positive volume is the day when noise trading induces trading volume (Lee, 2006).

The ZR measure is used to measure liquidity in the emerging markets of Latin America, East Asia, South Asia, Europe, the Middle East, and Africa by Bekaert, Harvey & Lundblad (2007) and by Lesmond (2005). Bekaert et al. (2007) applied Zero Returns (ZR) to 19 emerging stock markets, while Lesmond (2005) calculated different liquidity measures for 31 emerging equity markets. Lesmond (2005) and Bekaert et al. (2007) found that any country's liquidity is best measured by LOT's model (or ZR measure). The one practical drawback of LOT's measure is that it requires long enough periods (i.e., longer than one month) in order to estimate parameters. Moreover, too many zero-returns (i.e., more than 80% for the estimation period) make this measure invaluable. Bekaert et al. (2007) employed LOT's measure and they indicated that it is the only illiquidity measure applicable to emerging markets. Minović (2012) measured the level of liquidity in the Croatian market using the ZR measure by Lesmond et al. (1999). Using this measure she compared the liquidity of the Croatian and the Serbian markets. Minović's (2012) results showed that both markets have a low level of liquidity, while the Croatian market is less illiquid than the Serbian market.

4. METHODOLOGY

In order to estimate different factor models we used the Ordinary Least Squares (OLS) method in regression analysis. In regression analysis we included the Heteroskedasticity and Autocorrelation Consistent Covariances (HAC) method for consistent standard error estimates. The HAC method gives consistent estimates of standard errors in the presence of strange forms of heteroscedasticity and autocorrelation.

Various robustness checks were performed. To check the adequacy of the models we used: R^2 determination coefficient, F-test for regression significance, *t*-test for parameters significance in a model, Chow's tests of stability parameters[3], and tests of residuals analysis of the estimated model (Breusch-

[3] Chow's tests of stability parameters were applied because the observed sample period covered the period of global economic crisis. The changes in economic environment reflected on the value of parameters in regression models. The analysis of stability parameters is required to check the reliability of forecasting (Mladenović & Petrović, 2002).

Godfrey test and Jarque-Bera test) (Mladenović & Petrović, 2002). We have chosen the model that best describes the equilibrium of the Serbian stock market.

4.1. Data

We had daily data[4] for all stocks[5] listed on the Belgrade Stock Exchange (BSE) for the period October 14, 2005 – December 31, 2009. Daily returns are calculated as differences in log price at closing, as follows:

$$R_t^i = \log(P_t^i) - \log(P_{t-1}^i) = \log\left(\frac{P_t^i}{P_{t-1}^i}\right). \quad (5)$$

We used Zero Rates (ZR) return by Lesmond, Ogden & Trzcinka (1999) as a measure of stock illiquidity. In order to obtain and apply the corresponding illiquidity measure we created an application in Microsoft Access. ZR is calculated for each stock in each particular month. Then all stocks are sorted in each particular month according to the value of ZR in ascending order, using the application. For further analysis, we discarded stocks with zero returns in over 80% of cases, in each month. To diversify the part of returns specific to each company, as well as to get more precise estimations of beta coefficients, stocks were grouped in a portfolio. It was an equally weighted portfolio consisting of the 20 most liquid stocks.[6] The liquid portfolio is rebalanced monthly.

We calculated the level of illiquidity by ZR for the entire Serbian market. The acquired results are summarized in Table A1 in the Appendix. The Serbian

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4 Upon request we obtained prices and turnover data from the QuoteStation company at http://www.quotestation.com/

5 In the period 2005-2009 some 2000 stocks were listed on the Belgrade Stock Exchange.

6 We did not use the well-diversified BELEX15 market index for our portfolio, because it is a free-floating market capitalization weighted price index, which follows the movements of the most liquid shares traded by the continuous method. The change in the level of capitalization is not a representative measure of liquidity for an undeveloped market. Due to the illiquidity of the included securities the index composition is often modified, which is why this index is not the best choice (Minović & Živković, 2010).

market is shrinking because issuers withdraw their shares from it. The market is losing its capacity and even its very purpose for existence (average ZR value for the whole market is 0.972; see in Table A1 in the Appendix).

We got the data concerning the BELEX*line* index and its structure for 2005-2009 period from the Belgrade Stock Exchange (http://www.belex.rs/). The value-weighted return of this index is calculated using equation (5).

Treasury Bills (T-bills) are issued by the Republic of Serbia and were observed on the website of the National Bank of Serbia[7]. The Republic of Serbia's 3-month T-bills are used as the risk-free rate, and they represent the averaged weighted rate[8] for each month (in percents) on an annual basis.[9] These T-bills are not the true risk-free rates.

For calculating the two Fama-French (1993) factors (SMB and HML), we needed data about the number of shares outstanding and book value for all shares listed on the Belgrade Stock Exchange for the observed period 2005-2009. Upon request we obtained the number of shares outstanding on the Serbian market from the Belgrade Stock Exchange. We hand-collected the book value for all of the shares listed on the Belgrade Stock Exchange from the website of the Serbian Business Registers Agency[10] (SBRA). SMB and HML factors were calculated in the same way as in Fama & French (1993), as French explains on his website[11]. In order to calculate risk factors related to the size (SMB), we used market capitalization[12] as a proxy to measure the size of companies. Then we sorted all of the sample companies by market capitalization in each particular month. We formed two portfolios with an equal number of stocks (50:50): a

7 http://www.nbs.rs/export/internet/latinica/80/monetarni_sektor/SMS_najvaznije_kamatne_stope.xls

8 For months without available data we carried out extrapolation between two points in months with available data.

9 Aiming at evaluation of different factor models with daily data, we divided the observed T-bill rate by 360.

10 http://www.apr.gov.rs/.

11 http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html

12 Share price times number of shares outstanding.

small portfolio and a big portfolio each month. In order to calculate the book-to-market ratio value factor (HML factor), we sorted all companies from the sample by B/M ratio as a proxy, to measure the 'value effect' of stocks within two portfolios based on market capitalization (30:40:30). We then formed three portfolios based on B/M (value, neutral, and growth portfolios). In order to calculate the B/M factor in year t, we took the book value of the company in year *t* - 1. Finally, we formed six portfolios based on size and book-to-market ratio. In order to obtain Fama-French factors we created an application in Microsoft Access for sorting stocks by the value of their market capitalization and book-to-market ratio. The mean values and standard deviations of the formed equally weighted daily portfolio returns, based on size and book-to-market ratio, are presented in Table 1.

In Table 1 we can see that small companies have negative and significantly smaller average returns than big companies. However, the returns of big companies have higher standard deviation than the returns of small companies. The meaning of this may be that big companies hold potentially greater risk than small ones.

Table 1: The mean values and standard deviations of six equally weighted daily portfolio returns formed by size and book-to-market ratio.

(%)	R_{Value}^{Small}	$R_{Neutral}^{Small}$	R_{Growth}^{Small}	R_{Value}^{Big}	$R_{Neutral}^{Big}$	R_{Growth}^{Big}	SMB	HML
$E(R)$	-0.021	-0.024	-0.015	-0.014	0.000	0.016	-0.021	-0.018
σ	0.151	0.113	0.150	0.194	0.165	0.187	0.156	0.154

Note: E(R) = mean value of returns; σ = standard deviation. SMB factor relates to firm size; it is an average return on the three small portfolios, minus an average return on the three big portfolios. HML factor relates to the B/M ratio of companies; it is an average return on the two value portfolios, minus an average return on the two growth portfolios.

Source: authors' estimation

To calculate the liquidity risk factor (IML), we sorted stocks by illiquidity measure (ZR). Then we formed two decile portfolios: low-liquidity and high-liquidity portfolios. The IML factor is an average return on the one illiquid portfolio, minus an average return on the one liquid portfolio. Table 2 includes the mean values and standard deviations of the formed equally weighted daily portfolio returns based on the illiquidity measure (ZR).

The average return of illiquid stocks is negative and small, while the average return of liquid stocks is positive and higher. Both returns have a similar value of standard deviation (see Table 2).

Table 2: The mean values and standard deviations of the two formed equally weighted daily portfolio returns based on ZR measure.

(%)	$R_{10\%}^{Illiquid}$	$R_{10\%}^{Liquid}$	IML
$E(R)$	-0.110	0.036	-0.146
σ	0.960	0.954	1.303

Note: E(R) = mean values of returns; σ = standard deviation. IML is the factor of liquidity risk; it is the average return on decile portfolio with high liquidity risk, minus the average return on decile portfolio with low liquidity risk.

Source: authors' estimation

Usually, small company size, high book-to-market ratio, and illiquidity of stock are all associated with higher investment risks. Hence, investors require a size, growth, and liquidity premium as compensation for exposing themselves to these risks. This was the reason for having Fama-French's and Liu's methodologies instead of CAPM. It is specific in particular to the Serbian stock market, as well as to other emerging/frontier markets, especially to markets in the countries of former Yugoslavia and other Balkan countries. A similar situation was previously observed by Hearn et al. (2009) for the emerging African market, by Rahim & Nor (2006) for the Malaysian market, and by Halliwell et al. (1999) for the Australian market.

Table A2 in the Appendix shows the calculated average turnover and its relative change in the crisis period for the BELEX*line* index and liquid portfolio. Figure A1 in the Appendix presents daily turnover for the BELEX*line* index and liquid portfolio, respectively, for the observed period.

From Figure A1 in the Appendix we can see that the turnover of stocks from the BELEX*line* index decreased in the crisis period. Yeyati, Schmukler & Van Horen (2008) showed how trading activity increased as prices fell abruptly, declining only later as the crisis progressed. In Figure A1 we can see that our evidence is consistent with that of Yeyati at al. (2008). The exception is the last big peak (TO increase) in the last quarter of the year 2009 for the liquid portfolio. The increased uncertainty in the market discouraged all investors and they withdrew. Domestic individual investors, who by then were dominant, withdrew from the market and sold shares acquired in privatization. This 'withdrawal' effect is visible mainly for the most liquid stocks and it would have an affect on the increase of market illiquidity (for details, see Živković & Minović, 2010).

During the in-crisis period[13] the turnover of market index and liquid stocks decreased by more than 70% (see Table A2 in the Appendix). In this period the first measure of correlation between illiquidity measure and turnover is statistically insignificant for the market index and the liquid portfolio (see Table 3). This means that trading activity has slowed down dramatically in the Serbian equity market; trading with the most liquid stocks especially decreased in the crisis period. In the pre-crisis period the correlation coefficient between the illiquidity measure and turnover is very high (over -0.7) and statistically significant (see Table 3). The negative value of this coefficient means that when the level of illiquidity is high, it causes less trading and smaller turnover. The high absolute value of the correlation coefficient suggests that mostly liquid[14] stocks were traded on the Serbian market in the pre-crisis period.

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13 The breakpoint date between pre- and during-crisis is 01/10/2008. Lehman Brothers filed for bankruptcy protection on September 15, 2008. We have chosen October 1, 2008 as the breakpoint, because it marks a significant drop in turnover of the Serbian stock market index and liquid portfolio.

14 Some of the stocks (companies) with a significant effect on the liquidity of the Serbian market in these particular periods were: Hemofarm, Soja protein, Tigar, Energoprojekt, AIK banka, Alfa plam, etc.

Table 3: The correlation coefficient between the illiquidity measure (ZR) and turnover (TO), for BELEXline index and liquid portfolio, and for pre-crisis and in-crisis.

$\rho(ZR,TO)$	Pre-crisis	In-crisis
BELEX*line*	-0.72 [-5.96] (0.00)	-0.30 [-1.15] (0.27)
Liquid portfolio	-0.75 [-6.58] (0.00)	-0.39 [-1.51] (0.15)

Note: The value of *t*-statistics is in square brackets. The number in parentheses denotes *p*-value. The breakpoint date between pre- and in- crisis is 01/10/2008.

Source: authors' estimation

4.2. Regression factors

We performed regression analysis of the models represented by equations (6) - (10). Before performing the regression analysis we tested the stationarity of all time-series variables (see Table A3 in the Appendix). After having determined the stationarity of all time-series, the regression analysis followed. All regressions were estimated with daily time series. The results of regressions for an investor's liquid portfolio are summarized in Table 4.

Models	*Regression equation of models*	
CAPM	$R_t^p - R_t^f = \alpha_p + \beta_{p,M}\left(R_t^M - R_t^f\right) + \varepsilon_{p,t}$	(6)
LCAPM (Liu, 2006)	$R_t^p - R_t^f = \alpha_p + \beta_{p,M}\left(R_t^M - R_t^f\right) + \lambda_{p,IML} IML_t + \varepsilon_{p,t}$	(7)
FF	$R_t^p - R_t^f = \alpha_p + \beta_{p,M}\left(R_t^M - R_t^f\right) + \lambda_{p,SMB} SMB_t + \lambda_{p,HML} HML_t + \varepsilon_{p,t}$	(8)
LCAPM+SMB (Liu+SMB)	$R_t^p - R_t^f = \alpha_p + \beta_{p,M}\left(R_t^M - R_t^f\right) + \lambda_{p,SMB} SMB_t + \lambda_{p,IML} IML_t + \varepsilon_{p,t}$	(9)
LCAPM+FF (Liu+FF)	$R_t^p - R_t^f = \alpha_p + \beta_{p,M}\left(R_t^M - R_t^f\right) + \lambda_{p,IML} IML_t + \lambda_{p,SMB} SMB_t + \lambda_{p,HML} HML_t + \varepsilon_{p,t}$	(10)

Regression factors are:

R_t^M - The return of the market index BELEX*line*.

R_t^p - The equally weighted return of a portfolio consisting of 20 liquid stocks.

R_t^f - The risk-free rate, or the Republic of Serbia's T-bills.

$R_t^M - R_t^f$ - The excess market return

$R_t^p - R_t^f$ - The excess return of an investor's liquid portfolio

β - The slope coefficient. In standard CAPM it is the systematic risk, and is calculated by equation (2).

α - The coefficient of intercept, Jensen's α or abnormal return.

$\varepsilon_{p,t}$ - The error term, innovation, shock.

λ_{SMB}, λ_{HML}, λ_{IML} - The premiums related to market risk factors SMB, HML, and IML, respectively.

SMB_t - Small Minus Big - the factor related to firm size. SMB is the average return on the three small portfolios, minus the average return on the three big portfolios. We formed six portfolios that were rebalanced in each particular month. The SMB factor is calculated by the equation:

$$SMB = \frac{1}{3}\left(R_{Value}^{Small} + R_{Neutral}^{Small} + R_{Growth}^{Small}\right) - \frac{1}{3}\left(R_{Value}^{Big} + R_{Neutral}^{Big} + R_{Growth}^{Big}\right) \tag{11}$$

HML_t - High Minus Low - the factor related to the ratio of book to market value of companies. HML is the average return on the two value portfolios, minus the average return on the two growth portfolios. Portfolios were rebalanced in each particular month. The HML factor is calculated by the equation:

$$HML = \frac{1}{2}\left(R_{Small}^{Value} + R_{Big}^{Value}\right) - \frac{1}{2}\left(R_{Small}^{Growth} + R_{Big}^{Growth}\right) \tag{12}$$

IML_t - Illiquid Minus Liquid - the factor of liquidity risk. This factor is constructed as in Manzler (2005) and Liu (2004). At the beginning of each month, from October 2005 to December 2009, we sorted all stocks in ascending order based on their illiquidity measure (ZR). We formed two decile portfolios, the low-liquidity and the high-liquidity portfolios. This factor is formed as the average return on decile portfolio with high liquidity risk, minus the average return on decile portfolio with low liquidity risk (Manzler, 2005). Portfolios were rebalanced in each month. The IML factor is calculated by the equation:

$$IML = R_{10\%}^{Illiquid} - R_{10\%}^{Liquid} \qquad (13)$$

4.3. Limitations related to data and different variables

Since the Belgrade Stock Exchange was established in 2002, the period with data available for analysis is very limited. Much of the information needed for the analysis is not available for the entire period. Therefore it is not possible to eliminate all the problems with the data. We used relatively short time series (4.5 years long), as opposed to similar research conducted in developed markets where the available time series are more than 20 years long. Another problem is that the global economic crisis happened within the covered estimation period. The estimated parameters are unstable due to the crisis and no one of the chosen models could explain the long-term equilibrium and the variation of returns in the crisis period. The chosen models can describe well the equilibrium of the Serbian market until October 2008.

Tam (2007) suggests that proxy error can appear in constructing factors (or variables) in models. The used proxy cannot always correctly represent variables suggested by the models. In our case some variables may have proxy error, and they are: market index, risk free rate, chosen illiquidity measure, factors SMB, HML, and IML.

Market indices, especially the indices in undeveloped markets, are not good proxy for these markets. An index cannot fully reflect the market return for this type of market. A large portion of total capitalization in the Serbian market is highly illiquid. Many companies are listed on the exchange merely *de jure* rather than *de facto*. In addition, typically only a small fraction of such a company is floated. The index weighting is based on market capitalization. Changes in the level of capitalization are not a representative measure of market liquidity in Serbia. Due to the illiquidity of the included securities the index composition needed to be modified often, and that is why the BELEX index is not the best choice for a market proxy. However, because no better market proxy is available we used the BELEX*line* index. Therefore we expect proxy errors while testing the models, because we used inadequate market return (Minović & Živković, 2010).

The risk-free rate had to be adjusted to a one-day period, because the analysis was done using daily data. The data source of the Serbian risk-free rate is discontinuous, so it had to be extrapolated. We divided the observed T-bills rate by 360 in order to get a risk-free rate on a daily basis. The National Bank of Serbia[15] states on its website that the credibility and completeness of data is not guaranteed, for technical reasons. A potential error could appear in the model due to using suspicious or inadequate data, and due to adjusting the risk free rate to a daily level.

A potential error could also appear because the criterion for sorting stocks was the level of illiquidity measured by zero rate return (ZR). In general, in undeveloped markets a large number of stocks are not traded long-term. It is possible that this choice of measure introduces potential errors in testing. Non-trading may produce too many zero returns in the estimation period, thus rendering this measure unusable. Zhang (2010) showed that trading frequency is low in emerging markets because of high information asymmetry. He said that liquidity proxies which did not incorporate the trading frequency information could measure the underlying liquidity with more noise. Zhang (2010) studied measuring liquidity in 20 emerging markets, and he introduced a new measure for these types of market. Zhang (2010) pointed out that many of the more sophisticated liquidity measures which were applicable to developed markets required the use of high-frequency transactions and quote data, which was not available for some markets, especially emerging and frontier markets (Minović, 2011).

15 http://www.nbs.rs

Faff (2001) pointed out that problems related to the nature and construction of Fama-French factors have to do with firm size and book-to-market ratio of companies. This is especially true and very indicative (typical) of small and undeveloped markets, where comprehensive and reliable data covering sufficiently long periods are expensive to get and often non-existent. Tam (2007) explained that a potential for error lies in using size, or B/M ratio, as a sorting criterion for stocks. We used market capitalization as a measure of size. However, the concept of 'size' is multidimensional depending on the underlying criterion, such as turnover, number of employees, net assets, or market capitalization. Different criteria produce different values of SMB factor, and consequently different values of HML factor. This could affect regression analysis. The book value of stocks is subject to the accounting tradition and standards in each country. The authenticity and certainty of the book value data for undeveloped markets are of dubious quality.

Roll (1988) indicates that unsynchronized trading causes a serious problem of coefficient bias in daily regressions of stock returns. He maintains that the effects of this problem on determination coefficient R^2 are miniscule, and rather assigns its greater importance to slope coefficient, saying that big companies have been less sensitive to this problem. In our case daily data are stationary, so the regression results are the most reliable. For the estimated factor models (CAPM, LCAPM, FF, and LCAPM+FF) we obtained a relatively high value of R^2 coefficient (about 80%). Morck, Yeung & Yu (2000) have shown that R^2 is higher in countries with less developed financial systems, lower value of GDP, and poorer corporate governance.

5. EMPIRICAL RESULTS

From Table 4 we can see that the coefficient of determination (R^2) for all examined models is high, and is in the range from 78.97% to 80.15%. All regressions are statistically significant according to the *F*-test. Mladenović & Petrović (2002) pointed out that R^2 test-statistics are not in themselves enough to check the adequacy of the model. Therefore we choose the model according to the values of R^2, and the Breusch-Godfrey (BG) test of serial correlation in residuals. It is evident that LCAPM (Liu, 2006) and this model augmented by SMB factor are the only ones with no autocorrelation in residuals. Only these two are adequate, because residuals have autocorrelation at the confidence level of 10% in all other models, so they are not considered.

Table 4: Regression results with daily data for liquid portfolio. For market return, we used the return of the BELEX*line* index.

Liquid portfolio	α	β	λ_{IML}	λ_{SMB}	λ_{HML}	R^2 (%)	F	BG(5)
CAPM	0.000 [0.000] (0.000)	1.227 [0.034] (0.000)	-	-	-	78.97	4009 (0.000)	2.220 (0.050)
LCAPM (Liu, 2006)	0.000 [0.000] (0.004)	1.144 [0.030] (0.000)	-0.066 [0.012] (0.000)	-	-	79.99	2133 (0.000)	1.766 (0.117)
FF	0.000 [0.000] (0.000)	1.212 [0.038] (0.000)	-	-0.124 [0.093] (0.127)	0.064 [0.062] (0.299)	79.04	1340 (0.000)	2.436 (0.033)
Liu+SMB	0.000 [0.000] (0.023)	1.115 [0.033] (0.000)	-0.069 [0.012] (0.000)	-0.193 [0.093] (0.018)	-	80.13	1433 (0.000)	1.807 (0.109)
Liu+FF	0.000 [0.000] (0.016)	1.116 [0.033] (0.000)	-0.069 [0.012] (0.000)	-0.189 [0.094] (0.021)	0.072 [0.064] (0.259)	80.15	1075 (0.000)	1.900 (0.092)

Note: Standard errors of estimated parameters are given in square brackets, and p-values are in parenthesis. Values of determination coefficient (R^2), F-test for regression significance, and Breusch-Godfrey's (BG) test of serial correlation of fifth order are given.

Source: authors' estimation

According to the data from Table 4, we can tell that LCAPM (Liu, 2006) and its version augmented by SMB factor have a satisfactory statistical property, in the sense that, according to the BG test, there is no autocorrelation of fifth order in the residuals of these models. It means that the variables in these LCAPM models explain relatively well the many changes in price movements in the case of a liquid portfolio. According to the value of BG-test statistics, standard CAPM, Fama-French (1993) (FF), and LCAPM+FF models cannot explain the equilibrium of the Serbian market. However, for describing the equilibrium of this market, the LCAPM (Liu, 2006) model or LCAPM augmented by factor related to firm size could prove useful. The coefficient of determination for these two models is about 80%. This means that the variations in the market risk-premium, liquid risk-premium (by IML factor), and risk-premium of size (by SMB factor), respectively, can explain a major part of the liquid portfolio return. The remaining variation of about 20% cannot be explained by this model, or by its augmented version.

Recently, Chai at al. (2011) found that augmenting asset pricing models with a liquidity factor only resulted in a marginal improvement in the model's explanatory power. They suggested that the asset pricing models examined were not able to fully explain the common variation in Australian equity returns. We can say that, in the Serbian case, our results coincide with the mentioned findings by Chai at al. (2011).

Because the estimation period also covers the period of the global economic crisis of October 2008, we tested the stability of the parameters for all estimated models using Chow's tests (CBT - Chow Breakpoint Test, and CFT - Cow Forecast Test). The results of Chow's tests follow in Table 5. We used 01/10/2008 as a breakpoint in Chow's tests.

Table 5: The parameters of Chow's tests of stability in factor models.

Liquid portfolio	CAPM	LCAPM (Liu, 2006)	FF	Liu+SMB	Liu+FF
CBT	7.018 (0.000)	0.549 (0.649)	4.690 (0.000)	7.592 (0.000)	6.089 (0.000)
CFT	1.366 (0.000)	1.390 (0.000)	1.358 (0.000)	1.375 (0.000)	1.373 (0.000)

Note: The number in parentheses denotes *p*-value. The breakpoint date in Chow's tests is 01/10/2008. CBT is Chow Breakpoint Test, and CFT is Chow Forecast Test.

Source: authors' estimation

All estimated models showed an extreme instability of parameters (except Liu's LCAPM), and neither of these models can explain portfolio returns in the crisis period. The results of these two tests for chosen models (LCAPM and LCAPM+SMB) are presented in equations (14) and (15).

The estimated equations of selected models are as follows (standard errors of estimated parameters are in parenthesis):

LCAPM (Liu, 2006)

$$R_t^p - R_t^f = \underset{(0.030)}{1.144} \cdot \left(R_t^M - R_t^f \right) - \underset{(0.012)}{0.066} \cdot IML_t + \varepsilon_{p,t}$$
$$\mathrm{R}^2 = 0.80;\ \mathrm{CBT} = 0.55(0.65);\ \mathrm{CFT} = 1.39(0.00) \tag{14}$$

Liu+SMB

$$R_t^p - R_t^f = \underset{(0.033)}{1.115} \cdot \left(R_t^M - R_t^f \right) - \underset{(0.093)}{0.193} \cdot SMB_t - \underset{(0.012)}{0.069} \cdot IML_t + \varepsilon_{p,t}$$
$$R^2 = 0.80;\ \mathrm{CBT} = 7.59(0.00);\ \mathrm{CFT} = 1.38(0.00) \tag{15}$$

The value of the Chow Breakpoint Test (CBT) for LCAPM (Liu, 2006) tells us that the parameters of the estimated function of excess liquid portfolio return are stable for the entire observed period. The same is not true for the chosen LCAPM+SMB model. The value of the Chow Forecast Test (CFT) in fact tells us that neither model can adequately explain portfolio returns for the crisis period up to December 2009. Such results were expected, because market illiquidity increased in the crisis, thus causing disequilibrium of the market. On the other hand, the value of all stocks decreased in the Serbian market during the crisis, manifesting itself through a decreasing level of returns and all the premiums required by investors (see Table 6). The parameters of LCAPM+SMB are not stable in the pre- and in-crisis periods, according to the value of CBT. This model has been estimated again for two separate sub-periods, before October 2008, and after October 2008. The results are presented in Table 6.

Table 6: The results of testing Liu's LCAPM+SMB for two sub-periods, October 2005-September 2008, and October 2008-December 2009.

LCAPM+SMB (Liu+SMB)	α	β	λ_{IML}	λ_{SMB}	R^2 (%)	F	Q(36)
04.10.2005-30.09.2008	0.000 [0.000] (0.072)	1.136 [0.043] (0.000)	-0.072 [0.014] (0.000)	-0.114 [0.086] (0.184)	74.37	721.578 (0.000)	44.310 (0.161)
01.10.2008-31.12.2009	0.001 [0.000] (0.007)	0.950 [0.061] (0.000)	-0.083 [0.022] (0.000)	-2.301 [0.598] (0.000)	86.66	684.118 (0.000)	30.652 (0.721)

Note: Standard errors of estimated parameters are in square brackets and p-values are in parenthesis. Values of determination coefficient (R^2), F-test for regression significance, and Ljung-Box (Q-test) statistics of residuals are given.

Source: authors' estimation

Table A4 in the Appendix includes the results of testing CAPM and FF models for two separate sub-periods. The liquid portfolio value of R^2 in the pre-crisis period for both models is 73%, and about 85% in the crisis period. The high value of the coefficient of determination in these models is consistent with the evidence by Morck, Yeung & Yu (2000) for emerging markets. Mork et al. (2000) showed that high values of R^2 are common for countries with low GDP, less developed financial systems, and poorer corporate governance. Jin & Myers (2006) showed that increasing lack of transparency, combined with capture by insiders, leads to lower firm-specific risks for investors and to higher R^2. However, another test-statistic (BG and JB tests) of CAPM and FF models suggests that the specification for these models was wrong (see Table A4 in the Appendix).

From Table 6 we see that, in the crisis period, the SMB factor (the factor of profitability or size) plays a dominant role in explaining the variation of liquid portfolio return. Moreover, size premium has an even greater explanatory role than market premium and liquidity risk premium. The increase of the determination coefficient from 74% to 87% when the SMB factor is statistically significant in the crisis period, confirms this. In both sub-periods, market premium and liquidity risk premium play a significant role in explaining return variation. The HML factor is not significant in any of the regressions, so we can infer that it has no influence on the explanation of liquid portfolio return in the Serbian market. For both sub-periods the results indicated that an excess liquid portfolio return is the decreasing function of IML factor (market illiquidity).

The parameters of estimated Liu's LCAPM+SMB are presented in these equations (with standard errors of estimated parameters in parenthesis):

Pre-crisis
$$R_t^p - R_t^f = \underset{(0.043)}{1.136} \cdot \left(R_t^M - R_t^f\right) - \underset{(0.014)}{0.072} \cdot IML_t + \varepsilon_{p,t}, \quad R^2 = 74\% \tag{16}$$

In-crisis
$$R_t^p - R_t^f = \underset{(0.000)}{0.001} + \underset{(0.061)}{0.950} \cdot \left(R_t^M - R_t^f\right) - \underset{(0.022)}{0.083} \cdot IML_t - \underset{(0.598)}{2.301} \cdot SMB_t + \varepsilon_{p,t}, \quad R^2 = 87\% \tag{17}$$

In the pre-crisis period the factor of market risk premium has the greatest impact, followed by the factor of liquidity risk premium on the moving prices of the liquidity portfolio. After October 2008 the impact of market risk premium on the moving prices of the liquidity portfolio decreased, while the impact of liquidity risk premium and size premium increased. In the crisis period the SMB factor is the most dominant, which implies that this factor has the greatest impact on moving stock prices. The negative sign of the SMB factor means that big firms (firms with high capitalization) have a dominant role in the Serbian market. The beta coefficient is smaller than the one in the crisis period. In the conditions of global financial crisis, Serbia experienced a decline in domestic demand. Consequently, share prices were also in decline. Investors left their positions and sold stocks of the following liquid companies: AIK Banka, Agrobanka, Engeroprojekt, Komercijalna Banka, Soja protein, etc.[16] With the market being in a state of high illiquidity caused by the crisis, the decreasing rate of return for liquid portfolios is more significant. As a consequence of a more illiquid market, the value of the market index decreased significantly, leading to a significant decrease in the rate of return on liquid portfolios (see Figure 1A in

16 For details about the withdrawal of investors, see Živković & Minović (2010).

the Appendix, the last big peak [TO increased] in the last quarter of 2009 for liquid portfolio)[17].

In the crisis period, if the IML factor increases by 10%, representative investors holding a liquid portfolio of 20 stocks have to pay a greater illiquidity risk premium, i.e., 0.83% instead of 0.72%. Then, if the SMB factor increases by 10%, they have to pay a size risk premium of 23% while getting a smaller market risk-premium, i.e., 5% instead of 13.6%. The coefficient α is statistically significant in the crisis period, and it is 0.1%. It represents an abnormal return. However, if we bear in mind the significant fall of premiums, we can conclude that the value of a liquid portfolio decreased significantly after October 2008.

Our analysis demonstrates that classical CAPM has been developed to describe pricing of assets (equilibrium) in developed and liquid markets. As the Serbian market is undeveloped and illiquid we had to add some of the factors to this model in order to capture some of the characteristics of this market. The results showed that in the pre-crisis period Liu's LCAPM could explain well the mechanism for discovering the prices and equilibrium of the Serbian market. However, in the crisis period Liu's LCAPM augmented by SMB factor is more adequate, while LCAPM without SMB cannot adequately explain the portfolio returns of December 2009. Liquidity risk and size premium significantly effect price formation in Serbia. These results are consistent with Hearn et al. (2009) for the African emerging market, Rahim & Nor (2006) for the Malaysian market, and Halliwell et al. (1999) for the Australian market. Our findings also coincide with results by Chai et al. (2011) and Amihud et al. (2005), showing that liquidity has an important role in asset pricing. Thus, the hypotheses about the impact of liquidity and firm size on returns and about the superiority of LCAPM cannot be rejected. Both hypotheses are documented empirically.

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17 In the last quarter of 2009 AIK Banka stocks had the highest turnover. This turnover was 10-20 times greater than the turnover of other stocks.

6. CONCLUSION

In this paper, we tested different factor models on the Serbian stock market. We used the following models: CAPM, Fama-French (FF) model, Liu's (2006) LCAPM, and LCAPM+FF. To date no one has examined different factor models for the countries of former Yugoslavia (especially for Serbia). This is the first paper that deals with factor models such as the FF model and LCAPM with FF factors, applied to Serbia. We used data from the Belgrade Stock Exchange for the period from 2005 to 2009. Risk factors that have primary impact on equity price formation in the Serbian market are isolated. To measure illiquidity, we chose zero rate return by Lesmond, Ogden & Trzcinka (1999). We examined the impact of an overall market factor, the factor related to firm size, the factor related to the ratio of book to market value of companies, and the factor of liquidity risk on expected asset returns in the Serbian market. We used the Ordinary Least Squares (OLS) method in regression analysis in order to estimate different factor models.

Our resultant findings about the high value of R^2 in CAPM and FF models are consistent with the evidence offered by Mork et al. (2000) and Jin & Myers (2006). This high value of R^2 is common in countries with smaller GDP, less developed financial systems, and poorer corporate governance. Moreover, an increase in lack of transparency, combined with capture by insiders, leads to lower firm-specific risk for investors and to higher R^2. This confirms the fact that, in the Serbian market, insider information has a huge influence on investors' decisions. This finding coincides with Zhang's (2010) about high information asymmetry in emerging markets.

Our results indicate that Liu's two-factor LCAPM model performs better in explaining stock returns than CAPM and the Fama-French three-factor model. This is because classical CAPM and FF do not capture liquidity risk, which is the key problem in such small and undeveloped markets. The superiority of LCAPM tells us that high liquidity risk (high level of illiquidity) distorts the basic mechanism of price discovery in the Serbian market. Consequently, it is impossible to establish long-term equilibrium in this market. Liquidity has a significant impact on equity price formation in Serbia. Recently, Chai et al.

(2011) showed that liquidity has an important role in asset pricing. Amihud et al. (2005) showed that liquidity could explain the cross-section of assets with different liquidity, after controlling for other asset characteristics such as risk and the time series relationship between liquidity and securities returns. Our findings coincide with these results by Chai et al. (2011) and Amihud et al. (2005).

The results indicate that the excess liquid portfolio return is a decreasing function of market illiquidity. In a state of low market returns and high illiquidity an investor's premium is significantly decreased. The firm size (SMB factor) has a highly negative and statistically significant value. This means that the firm size factor has a greater impact on portfolio return. Returns decrease significantly when the value of this factor (negative coefficient by SMB) increases. On the other hand, the negative sign of SMB factor means that big firms have a dominant impact on the fall of investor portfolio rate in Serbia. The impact of this factor is greater in the crisis period. The HML factor was irrelevant in explaining stock returns on the Serbian market. We can infer that its explanatory power is very limited in Serbia. By contrast, the SMB factor has greater power than HML in explaining liquid stock returns on this market. In all tested models this factor improves significantly the ability of models to explain the variations of asset return (increased R^2). In conclusion, we may say that the Fama-French model and LCAPM combined can improve the description of equilibrium in the Serbian market.

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APPENDIX

Table A1. The mean of ZR measure for the Serbian market as a whole and for the entire period observed (2005-2009), in the case when excluded stocks have more than 80%, 90%, and 99% of zero returns, respectively.

ZR measure	to 80%	to 90%	to 99%	All stocks
whole market	0.506	0.629	0.763	0.972

Note: The average value of ZR measure is given considering all of the stocks that have ever existed in the market.

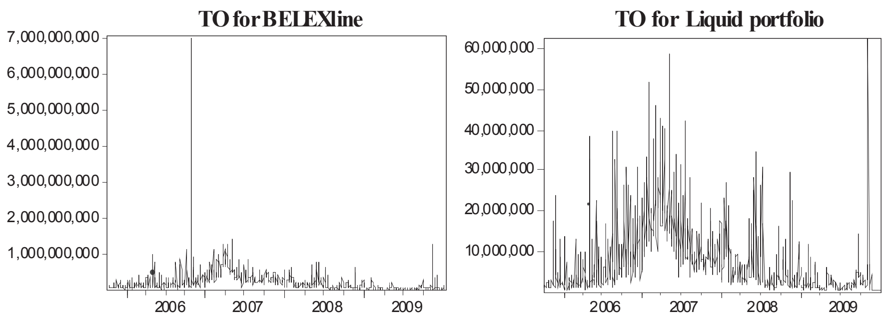
Source: authors' calculation

Table A2: The average value of daily turnover in RSD for BELEX*line* index and liquid portfolio, the average value of daily turnover in the pre-crisis and in-crisis period, and its relative changes.

Turnover in RSD	Average	to 30/09/2008	from 01/10/2008	Relative changes in TO
BELEX*line*	207,845,035	268,165,400	66,280,679	-75.3%
Liquid portfolio	7,240,903	9,251,946	2,514,952	-72.8%

Source: authors' calculation

Figure A1. Daily turnover for observed period.



Source: authors' calculation

Table A3. The results of testing a unit root in daily time series for log data, log returns of the BELEX*line* index, and of liquid portfolio, FF factors and the factor of liquidity risk, respectively.

	Series	ADF Test	level	Critical Value	H_0
BELEX*line*	$P_{M,t}$	-1.20	5%	-3.41	cannot be rejected
	$R_{M,t}$	-20.96	5%	-3.41	*rejected*
	$R_{M,t}$-$R_{f,t}$	-21.03	5%	-3.41	*rejected*
Liquid portfolio	$R_{p,t}$	-21.71	5%	-3.41	*rejected*
	$R_{p,t}$-$R_{f,t}$	-21.77	5%	-3.41	*rejected*

FF factors	SMB_t	-26.61	5%	-3.41	*rejected*
	HML_t	-9.915	5%	-3.41	*rejected*
Factor of liquidity risk	IML_t	-18.089	5%	-3.41	*rejected*

Note: The null hypothesis H_0: unit root exists in the process (for example $R_{M,t}$~I(1)); the alternative hypothesis: the process is stationary (for example $R_{M,t}$~I(0)). $P_{M,t}$ = logBELEX*line*, $R_{M,t}$ = dlog(BELEX*line*); $R_{p,t}$ is log portfolio return of 20 most liquid stocks. SMB_t is the factor related to firm size, and it is the average return on the three small portfolios, minus the average return on the three big portfolios. HML_t the factor related to the B/M ratio of companies, and it is the average return on the two value portfolios, minus the average return on the two growth portfolios. IML_t is the factor of liquidity risk, and it is the average return on decile portfolio with high liquidity risk minus the average return on decile portfolio with low liquidity risk.

Source: authors' estimation

Table A4. The results of testing CAPM and FF models, for two sub-periods, October 2005-September 2008, and October 2008-December 2009.

Liquid portfolio	Period	α	β	λ_{SMB}	λ_{HML}	R^2 (%)	F	BG(5)	JB
CAPM	04/10/05-30/09/08	0.000 [0.000] (0.011)	1.242 [0.042] (0.000)	-	-	72.78	2000 (0.000)	2.531 (0.028)	55.144 (0.000)
	01/10/08-31/12/09	0.000 [0.000] (0.006)	1.218 [0.050] (0.000)	-	-	84.89	1786 (0.000)	3.544 (0.002)	50.258 (0.000)
FF model	04/10/05-30/09/08	0.000 [0.000] (0.017)	1.229 [0.044] (0.000)	-0.077 [0.082] (0.350)	0.053 [0.059] (0.370)	72.85	667.187 (0.000)	2.708 (0.020)	56.884 (0.000)
	01/10/08-31/12/09	0.000 [0.000] (0.000)	1.104 [0.091] (0.000)	-1.673 [0.700] (0.018)	0.164 [0.545] (0.764)	85.62	627.260 (0.000)	2.355 (0.018)	8.697 (0.013)

Note: Standard errors of estimated parameters are in square brackets and p-values are in parenthesis. Values of determination coefficient (R^2), F-test for regression significance, Breusch-Godfrey's test (BG) of serial correlation of fifth order in residuals, and Jarque-Bera (JB) test of normality of residuals are given.

Source: authors' estimation

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