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How to Measure Illiquidity on European Emerging Stock Markets?

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Abstract

Background: Liquidity is, in practice of portfolio investment, an important attribute of stocks and measuring illiquidity presents a real challenge for researchers, primarily on developed stock markets. Moreover, there is a lack of research dealing with (il)liquidity on emerging markets. In the paper, the problem of applicability and validity of two well-known illiquidity measures, ILLIQ and TURN, on European emerging markets is observed. **Objectives:** The paper has two main purposes. The first is to test the relative performance of the two selected illiquidity measures in terms of their validity on European emerging stock markets. The second is to propose a new and improved illiquidity measure named Relative Change in Volume (RCV). **Methods/Approach:** Using daily returns and traded volumes for 12 stocks which are constituents of stock indices on seven observed markets, ILLIQ and TURN along with the new proposed measure are calculated and tested based on correlation with return. All measures are tested and proposed using the single stock approach. **Results:** It is shown that ILLIQ and TURN are not appropriate for seven observed markets. The measures do not follow the obligatory request that returns increase in illiquidity while RCV has the ability of taking into account the pressure of big differences in volume on return. RCV gives satisfactory results, making clear the distinction between liquid and illiquid stocks and between liquid and illiquid markets. **Conclusions:** The proposed measure potentially has important implications in illiquidity measurement in general, and not only for investors on emerging stock markets.

Keywords: illiquidity measures; emerging markets; Relative Change in Volume-*RCV*

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Introduction

It is generally accepted that liquidity, among many other indicators, is important attribute of stocks which influence investors' portfolio decision making. Investor should be able to sell stock to meet his liquidity objectives without major trading costs. Its evident importance in practice led to intense research interest in the last two decades. For example, Amihud and Mendelson (1986) point out that the role of liquidity in capital markets is hardly reflected in academic research. One decade later Aitken and Winn (1997) report that there are 68 liquidity measures used in the literature. The examined literature reveals that the interest in illiquidity measurement has not declined ever since.

Amihud and Mendelson (1986) studied the effect of the bid-ask spread on assets pricing. They concluded that effect of firm size on stock returns was negligible and highly insignificant. The results show that excess returns increase along with spread.
Pagano (1989) predicted a positive relation between volatility and market thinness or illiquidity explaining that thin markets cannot accommodate temporary bulges of buy or sell orders without large price movements. Thus market thinness tends to increase the volatility of assets prices and their tendency to react adversely to the orders of traders - two features that are obviously unappealing to investors.
Aitken and Winn (1997) suggest that there is little agreement on the best measure to use. They also report that there is little or no correlation between many of these metrics suggesting that inappropriate measures may result in exchanges reaching the wrong conclusions about changes in market structure.

Pastor and Stambaugh (2003) define liquidity as the ability to trade large quantities quickly, at low cost, and without moving the price. They founded that expected stock returns and the sensitivities of returns to fluctuations in aggregate illiquidity relation is cross-sectional. Stocks that are more sensitive to aggregate liquidity have substantially higher expected returns, even after they accounted for exposures to the market return as well as size, value and momentum factors.

According to Bekaert et al. (2007) long periods of consecutive non-trading days should be associated with greater illiquidity effects than non consecutive periods. They employed the zero measures indicating simply the proportion of zero daily returns averaged over months. The fact that the zero measure correlates negatively with turnover is indirect evidence supporting that longer periods of consecutive non-trading are associated with greater illiquidity effects. Their measure attempts to take this return catch up effect into account.

Moreover, in the context of illiquidity measurement, emerging stock markets also gain some importance due to its distinct features. Bekaert et al. (2007) found that local market liquidity is important driver of expected returns in emerging markets. They concluded that there is no consistent pattern in the correlation between estimates of conditional volatility and the liquidity measure. According to them correlation is as often positive as it is negative, though economically small in most cases. On average, correlation is effectively zero. Minovic (2012) was determining level of the Croatian market illiquidity and comparing it with level of the Serbian market illiquidity. Results showed that the level of liquidity for the Croatian market is very low. Lischewski and Voronkova (2012) investigate whether liquidity helps explaining stock returns in Poland. They concluded that liquidity is not a priced factor on the Polish market. This may potentially have important implications for making accurate inferences with regard to asset pricing as liquidity is deemed to be particularly important in the context of emerging markets where the number of securities, number of traders and efficiency of trading mechanisms is likely to be lower than in the developed markets.

Because of different influences on/off illiquidity, the challenge of finding a single measure that captures all its aspects still remains.

Previous literature generally consists of two large groups of liquidity measures; that are trade based and order based measures. Trade based measures include trading value, trading volume, the number of trades (frequency) and the turnover ratio. These measures are attractive, as they can be easily calculated using available data on stock prices and traded volumes. According to Aitken and Comerton-Forde (2003) these measures have wide acceptance particularly among market professionals. Order based measures are based on the more detailed trading data like data from order book. There is a little correlation between the trade based and order based measures suggesting that the choice of measure may have a significant effect on research outcomes and therefore policy decisions.

Many authors have concluded that liquidity is easy to define but has proved to be difficult to measure. In general, empirical findings support assumption that expected returns are increasing in illiquidity. Fulfilling this assumption an illiquidity measure can be considered as valid measure. The question is whether these measures are valid on emerging markets since these markets are characterized by great illiquidity and by problem of illiquidity measurement.

Today on world stock markets two measures are the most popular and used: *ILLIQ* (Amihud 2002) and *TURN* (Datar at al. 1998), both from the group of trade based measures. Datar et al. (1998) examined asset returns and liquidity by using a turnover ratio (*TURN*), defined as the number of shares traded divided by number of shares outstanding, as a proxy for liquidity. Authors founded that stock returns are strongly negatively related to their turnover rates confirming the notion that illiquid stocks provide higher average returns for non-financial firms from the NYSE. Chan (2003) concluded that turnover as a proxy for liquidity has been an important priced factor, forming a strong negative relationship with returns on Australian stock market. Dey (2005) founded evidence that the significantly increasing relation between turnover and return is true exclusively for the emerging markets, and that developed markets show a significant relation between return and volatility but not between turnover and return. Amihud (2002) examines the average ratio of the daily absolute return to the dollar trading volume on that day for the U.S. market. It can be interpreted as the daily price response associated with one dollar trading volume thus serving as a rough measure of price impact. Author found that stock returns are negatively related over time to contemporaneous unexpected illiquidity, suggesting that illiquidity affects more strongly firms with smaller market capitalization. Miralles et al. (2004) used Amihud's illiquidity ratio as the best proxy for illiquidity on Spanish stock market. They concluded that systematic illiquidity should be a key ingredient of asset pricing. Vidović (2013) questioned existence of illiquidity premium on 8 Central and South East European stock markets. Using the ILLIQ illiquidity measure proposed by Amihud (2002) liquidity of each stock was observed in monthly and half-year period. Naïve portfolio diversification in forming liquidity sorted portfolios was applied. Vidovic concluded that by observing illiquidity through ILLIQ and sorting illiquid stocks in equally weighted portfolio investors cannot expect illiquidity premium on observed markets in one month and half year periods.

Through the literature inspection it can be seen that authors define liquidity in various ways and measure liquidity using different approaches. There is no consensus about the most appropriate measure.

In this paper we investigate problem of illiquidity measures' validity observing stock returns and related traded volumes on selected Central and South-East European emerging markets. Our approach is based on observation of single stock

liquidity while we have reason to believe that changes in traded volume can result in increase of stock return or decrease of stock return as suggested in Dey (2005). Emerging markets are thin what can be concluded from observing market capitalization and number of listed companies (Pagano, 1989). Common situation on these markets is absence of quality stocks to be traded with what makes a big pressure on the demand for stocks of good companies. According to Bekaert et al. (2007) another problem is long non-trading periods associated with greater illiquidity effects. The majority of trading during the longer periods is reserved for few most interesting stocks.

The goal of this paper is to show rather poor performance of ILLIQ and TURN on European emerging stock markets and to propose better solution in form of the new measure - Relative Change in Volume (*RCV*). The proposal of new illiquidity measure, along with single stock approach, makes the contribution of this paper to the field of illiquidity measurement.

The paper is organized as follows: after this introductory section the data and two selected illiquidity measures are defined. In the third part these two illiquidity measures are tested. Since these measures do not confirm the main validity assumption on observed emerging markets, in the next part of the paper the new measure – Relative Change in Volume - is proposed and tested. At the end of the paper we bring discussion with the most important conclusions.

Methodology

Data

Data for this study are obtained from REUTERS database and include information on stock returns and traded volumes for 12 stocks which are constituents of stock indices on seven observed markets. Selected markets are placed in Central and South-East Europe and include stock markets of EU member states: Poland, Czech Republic, Hungary, Bulgaria, Romania, Croatia and Germany as a benchmark. Data consist of around 500 daily observations in period from the beginning of November 2009 to the end of October 2011.

Some characteristics of observed markets are given in Table 1. In general all observed markets are thin compared to German stock market and New York Stock Exchange. Table 1 shows very clearly that emerging markets have negligible market capitalization, turnover and number of listed shares. Istanbul and Warsaw stock exchange have the best performances in the group of emerging markets, but still far behind the benchmarks. Investor willing to invest in stocks from these markets is facing with variety of problems. The major problem is infrequent trading. The most common situation on these markets is a trade for a day or two followed by a short non trading period. This inconsistency in trading corresponds to jumps and falls in traded volumes what could make pressure on stock returns.

Daily data are employed for the calculation of daily fluctuations in stock returns and traded volumes. This gives us an opportunity to capture day by day variations in returns and traded volumes, and allows us examination of liquidity effects across a large number of stocks and countries.

Table 1
Features of Observed Emerging Markets and Benchmarks

Exchange	Market capitalization value at the end of the month (EUR m)	N° of companies with listed shares	Turnover (EUR m)
Bucharest Stock Exchange	12.722,64	79,00	489,1
Bulgarian Stock Exchange	6.174,27	392,00	50,8
CEESEG – Budapest	16.773,56	52,00	3.427,90
CEESEG – Prague	29.927,35	27,00	3.867,80
Deutsche Börse	1.038.389,74	746,00	370.234,00
Istanbul Stock Exchange	190.880,78	265,00	91.404,80
NYSE Euronext	1.958.378,00	1.109,00	433.025,00
Warsaw Stock Exchange	122.158,45	808,00	16.123,80
Zagreb Stock Exchange	17.629,92	246,00	138,44

Source: Federation of European Stock Exchanges FESE, values on the March 31, 2012 and Zagreb Stock Exchange

Methods

In this research we use well known Amihud's proxy for illiquidity *ILLIQ* for each stock in the form as given in Ghiysels and Pereira (2004):

$$ILLIQ_i = \frac{1}{I}\sum_{t=1}^{I} |R_{it}| / V_{it} P_{ti} \quad (1)$$

where R_{it} is the daily return on stock i on day t, V_{it} is the respective daily volume, P_{it} is the price of stock i on day t and I is the number of days for which data are available for stock i. In literature *ILLIQ* is often referred as measure of price impact (*PI*).

Daily return is calculated in continuous time:

$$R_{it} = \ln\left(P_{it} / P_{i,t-1}\right) \quad (2)$$

Turnover rate measure of liquidity *TURN* is employed from Datar at al. (1998):

$$TURN_i = \sum_{t=1}^{I} V_{it} \Big/ N_i \quad (3)$$

where N_i is the number of shares outstanding.

Applying these measures on observed emerging markets we found that they are not adequate, lead to inconsistent conclusions with no statistically significant relations between stock returns and illiquidity.

Results

In this part of the analysis we test two most commonly used illiquidity measures, *ILLIQ* and *TURN*, previously defined by relations (1) and (3). We use Pearson correlation coefficient to determine the strength and direction of relation between return and two applied illiquidity measures. These measures are very easy to calculate from widely available data on stock returns, volume and the number of shares outstanding. Our findings in this analysis do not support the findings of Amihud (2002) and Datar et al. (1998). When observing every stock individually we found that each stock does not react to proven illiquidity in the same direction and/or with the same strength. Tables 2 – 8 show results of *TURN* and *ILLIQ* and their correlation with return based on series of daily data for each observed country using single stock approach for 12 stocks with the highest weight in the stock index.

Table 2
TURN, *ILLIQ* and Correlations with Return for Zagreb Stock Exchange

Croatia	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
HT	0,0003	-0,2145**	1,029E-09	-0,0682
ADGR	0,0002	0,0816	4,797E-08	-0,0072
PODR	0,0003	0,0713	2,229E-07	0,0104
ERNT	0,0004	0,1761**	2,977E-08	-0,0072
ZBB	0,0000	0,2351**	2,942E-07	-0,0173
KRAS	0,0002	0,2018**	2,642E-07	-0,0091
ATPL	0,0007	0,0289	2,424E-08	0,0272
KONCAR	0,0003	0,1012	1,511E-07	-0,0925
ATGR	0,0002	-0,1106*	6,530E-08	-0,0852
PTKM	0,0007	0,0962	6,298E-07	0,0889
ADPL	0,0007	0,0635	2,843E-07	0,0121
KNZM	0,0000	0,0515	1,893E-06	0,0820

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level
Source: Authors' work

According to Table 2, the results of correlation analysis do not support the hypothesis that stock returns increase in illiquidity on Croatian Stock Market. Return and illiquidity correlation in case of *ILLIQ* is statistically insignificant and has not positive sign in all cases as expected by Amihud (2002). *TURN* gives better results indicating in some cases significant but week relation to stock returns. However, the direction of that relation is in most cases positive, meaning that stock returns increase in liquidity, which is opposite to conclusions of Datar et al. (1998).

Results for stocks from Hungarian stock market (Table 3) through *ILLIQ* measure show negative but insignificant relation between illiquidity and stock return what does not support the findings of Amihud (2002). According to turnover rate most stocks from Hungarian stock market do not show strong relation between liquidity and stock returns, only in two isolated cases this relation is significant and negative, but week.

Table 3
TURN, *ILLIQ* and Correlations with Return for Budapest Stock Exchange

Hungary	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
MOL Magyar Olaj	0,0000	-0,0353	1,570E-03	-0,0243
OTP Bank	0,0082	-0,1881**	1,834E-12	-0,0862
Richter Gedeon	0,0017	0,0101	1,278E-11	-0,1067
Magyar Telekom	0,0018	-0,1235**	1,352E-11	-0,0263
EGIS	0,0014	0,0528	1,194E-10	-0,0153
Raba Automotive	0,0039	0,0647	8,019E-10	-0,1344
FHB Jelzalogbank	0,0007	-0,0506	5,401E-10	-0,1173
E Star	0,0030	0,0490	1,425E-09	-0,0374
PannErgy	0,0027	0,0540	5,052E-10	0,0018
EST MEDIA	0,0043	0,0077	2,690E-09	-0,0729
ORCO PROPERTY			5,558E-09	-0,0001
Fotex Holding			2,133E-07	-0,0476

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level; The number of shares outstanding could not be found for the last two stocks.
Source: Authors' work

When observing data for Czech market (Table 4) *ILLIQ* measure confirms negative relation between stock returns and illiquidity, but the turnover rate as proxy for liquidity does not support this hypothesis giving significant correlations between stock returns and liquidity measure with positive and negative sign.

Table 4
TURN, *ILLIQ* and Correlations with Return for Prague Stock Exchange

Czech Republic	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
Cez	0,0010	-0,1376**	2,447E-11	-0,0652
Komercni Banka	0,0018	-0,0545	5,678E-11	-0,0647
Telefonica Czech	0,0000	-0,0432	7,181E-11	-0,3009
Erste Group	0,0006	-0,1682**	1,187E-10	-0,1581
New World Resour	0,0021	0,0421	1,960E-10	-0,0505
Unipetrol	0,0009	-0,0664	6,969E-10	-0,0251
VIG	0,0001	-0,0212	4,636E-09	-0,0599
Philip Morris CR	0,0008	0,0129	2,156E-09	-0,0235
Central European	0,0021	0,0671	7,166E-10	-0,0837
PEGAS NONWOVENS	0,0014	0,0671	3,586E-09	-0,0609
ORCO PROPERTY	0,0007	0,2164**	2,077E-08	-0,0247
AAA Auto Group	0,0003	-0,2094**	4,989E-08	0,1027*

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level
Source: Authors' work

In case of Poland (Table 5), liquidity measures are not consistent relating the strength and direction of the relationship between return and liquidity measures. While *ILLIQ* indicates positive but insignificant relation between stock return and illiquidity, turnover rate shows positive relation between increase in liquidity and increase in stock return, which is opposite to conclusions of Datar et al. (1998).

Table 5
TURN, *ILLIQ* and Correlations with Return for Warsaw Stock Exchange

Poland	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
PKO BP	0,0022	0,0508	1,495E-10	-0,1262
KGHM Polska	0,0049	-0,0886	1,499E-10	0,0646
Pragma Faktoring	0,0012	0,0900	1,111E-05	0,0658
INTERSPORT	0,0003	0,1124*	5,813E-05	0,0792
Skyline Investme	0,0008	0,1495**	4,395E-06	0,0532
UniCredit	0,0000	-0,0538	1,625E-06	-0,0208
COMPLEX	0,0003	0,1033*	1,469E-05	0,1023*
CASH FLOW	0,0018	0,3269**	3,154E-05	0,0654
MEDIATEL	0,0006	0,3439**	3,049E-05	0,0688
WADEX	0,0003	-0,0285	1,963E-05	-0,0077
BELVEDERE	0,0003	0,3681**	3,850E-06	-0,0154
WANDALEX	0,0008	0,1585**	2,130E-05	0,1166**

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level
Source: Authors' work

All stocks from Bulgarian stock market (Table 6) show positive but weak relationship between illiquidity (*ILLIQ*) and stock returns while stocks on Romania stock market

(Table 7) do not show consistent pattern. According to turnover rate in some cases stocks show positive relationship between stock returns and turnover rate suggesting that increase in traded volumes should result in increase of stock returns.

Table 6
TURN, *ILLIQ* and Correlations with Return for Sofia Stock Exchange

Bulgaria	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
Spharma	0,0002	-0,0762	1,398E-06	0,0619
Advance Terrafun	0,0004	-0,1225*	1,583E-05	0,0420
Monbat	0,0002	0,0209	4,123E-06	0,0104
Chimimport	0,0003	0,0560	2,243E-06	0,1315**
Eurohold Bulgari	0,0007	0,0805	4,149E-06	0,0710
Stara Planina Ho	0,0003	0,1209**	9,693E-06	0,0323
Fibank	0,0002	-0,0107	7,352E-06	0,1644**
Kaolin	0,0001	0,0296	1,249E-05	0,0685
M+Hydraulic	0,0002	0,0164	2,205E-05	0,1784**
BREF	0,0013	0,0602	8,671E-05	0,0455
Tsentralna banka	0,0004	0,1473**	3,216E-05	0,0210
IHB	0,0005	-0,0503	4,844E-05	0,0521

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level
Source: Authors' work

Table 7
TURN, *ILLIQ* and Correlations with Return for Bucharest Stock Exchange

Romania	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
OMV Petrom	0,0001	0,0452	3,366E-08	-0,0758
BRD-Groupe SG	0,0002	-0,0514	2,930E-08	-0,0682
Alro	0,0000	-0,0734	2,076E-06	0,0559
Transgaz	0,0002	-0,1142**	8,266E-08	0,0230
Banca Transilvan	0,0007	0,0509	2,310E-08	-0,0583
Transelectrca	0,0002	0,0111	2,762E-07	-0,0452
Rompetrol	0,0001	0,0612	1,946E-05	0,0509
Azomures	0,0008	0,3421**	5,922E-07	0,0441
Oltchim	0,0011	0,3181**	1,646E-06	0,0000
Zentiva	0,0002	0,1420**	4,811E-06	-0,2122**
Biofarm	0,0011	0,0694	2,527E-07	-0,0696
Antibiotice	0,0003	0,0412	8,962E-07	0,0575

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level
Source: Authors' work

For the greatest European market – German stock market (Table 8), results are contrary. The smallest values of *ILLIQ* measure and the highest values of *TURN* measure among all observed markets, indicate liquid market. The same conclusion can be derived from Table 1 according to market capitalization data.

Table 8
TURN, *ILLIQ* and Correlations with Return for Frankfurt Stock Exchange

Germany	*TURN*	Correlation between return and *TURN*	*ILLIQ*	Correlation between return and *ILLIQ*
SAP	0,0036	-0,0674	6,23E-11	-0,0241
K S	0,0078	-0,0569	2,18E-10	-0,0223
Heidelberg Cement	0,0064	-0,0965	4,09E-10	-0,0347
Lufthansa	0,0085	-0,1828**	3,17E-10	-0,0178
Metro	0,0034	-0,0799	2,95E-10	-0,0234
RWE	0,0052	-0,2147**	9,91E-11	-0,0393
Henkel	0,0053	0,0992	2,89E-10	0,0464
COMMERZBANK	0,005	-0,066	2,78E-10	-0,0636
BMW	0,005	-0,0452	1,19E-10	0,0595
Beiersdorf	0,0026	0,01	3,40E-10	-0,0087
Munich Re	0,0062	-0,1350**	9,80E-11	0,034
Linde	0,0037	-0,1037*	1,83E-10	0,0656

Note: **Correlation is significant at the 0.01 level; *Correlation is significant at the 0.05 level
Source: Authors' work

In general it can be concluded that this two widely accepted liquidity measures do not drive to equal and/or valid conclusions regarding stock illiquidity performances on observed emerging markets.

A proposal of new illiquidity measure

This paper attempts to shed light on the relation between liquidity and asset returns using a proxy for liquidity that is different from the order based measures relying on bid-ask spread and somewhat similar to the trade based measures like Amihud's *ILLIQ* or Datar's *TURN*.

The new proposed measure is very easy to calculate from the data on traded volume and stock returns in observed period. Our measure of illiquidity attempts to take into account the pressure of big differences in volume on return. Stocks that do not trade continuously have a potential price pressure of any trade following a non trading interval (Bekaert et al., 2007).

We measure the Relative Change in Volume in the following way. In the first step we calculate Average trading volume (*AVV*) for each stock in the observed period:

$$AVV_i = \sum_{t=1}^{I} V_{it} \Big/ I \qquad (4)$$

In the second step we calculate Relative Daily Change in Volume (*RDCV*) as the absolute difference between traded volume on day t and t-1 over average volume for each stock in observed period:

$$RDCV_{it} = \left| V_{it} - V_{i,t-1} \right| \Big/ AVV_i \ . \qquad (5)$$

This ratio defines daily change of traded volume in respect to average traded volume of that stock for day *t*.

RDCV measures daily illiquidity, when it is calculated for the whole period it represents illiquidity measure of single stock – Relative Change in Volume - *RCV*:

$$RCV_i = \sum_{t=1}^{I} RDCV_{it} \Big/ I \ . \qquad (6)$$

Proposed illiquidity measure gives information about the stocks liquidity status. For example stocks that have compact trading volumes i.e. which have small

differences between t and t-1 volume in comparison to average volume in that period have illiquidity measure under 1. Stocks whose differences in daily traded volumes approach to the average traded volume in that period have illiquidity ratio up to 1. Last category consists of illiquid stocks with RCV above 1. These stocks may have price pressure related to huge differences in traded volumes which exceed the average daily volume in observed period. This illiquidity measure is appropriate for emerging markets while it captures the main problems on these markets such as infrequent trading and small number of good stocks to be traded with.

To show possible good properties of Relative Change in Volume (*RCV*) we employ *RCV* on emerging stock markets.

From Table 9, the value of *RCV* suggests that the most liquid stock on Croatian stock market in observed period is HT, as can be arguably confirmed from practice and values of all other stock market indicators. Among all the others, it is also contributed by the largest number of trading days, negative daily return and small risk, measured by standard deviation. KNZM is illiquid stock. It has the *RCV* value of 1.14765, which is above 1. That is supported by the lowest number of trading days, high risk and positive daily expected return. Here it has to be emphasized that in cases of illiquid stocks we can see either small number of trading days or illiquidity caused by small daily volumes.

Table 9
RCV on Croatian Stock Market

Stock	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
HT	502	-0,00018	0,01029	0,54144
ADGR	502	-0,00046	0,01147	0,97502
PODR	502	-0,00018	0,01574	1,06118
ERNT	502	-0,00048	0,01508	0,79083
ZBB	488	-0,00035	0,01992	1,20395
KRAS	502	0,00116	0,01494	1,03168
ATPL	502	-0,00177	0,01522	0,55896
KONCAR	496	0,00021	0,01378	1,02341
ATGR	501	-0,00057	0,00966	1,14765
PTKM	495	0,00047	0,02231	0,93829
ADPL	497	0,00059	0,02070	0,73430
KNZM	456	0,00028	0,02208	1,14015

Source: Authors' work

Results from Hungarian stock market (Table 10) indicate liquid market with *RCV* values for all but one stock below 1. Moreover, these stocks have negative expected returns and most of them relatively small risk measured with standard deviation, with large number of trading days. Only E Star has the value of *RCV* above 1 indicating illiquid stock, supported by the only positive expected return and relatively high risk.

Table 10
RCV on Budapest Stock Exchange

Stock	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
MOL Magyar Olaj	505	0	0,023	0
OTP Bank	504	-0,0011	0,0274	0,3857
Richter Gedeon	505	-0,0003	0,0174	0,5544
Magyar Telekom	505	-0,0007	0,0157	0,5452
EGIS	505	-0,0001	0,0177	0,7865
Raba Automotive	502	-0,0003	0,0192	0,7198
FHB Jelzalogbank	504	-0,0019	0,0213	0,7738
E Star	503	0,0007	0,0213	1,0624
PannErgy	505	-0,0005	0,0138	0,9195
EST MEDIA	498	-0,002	0,0444	0,8054
ORCO PROPERTY	498	-0,001	0,0309	0,8096
Fotex Holding	505	-0,0007	0,0176	0,8645

Source: Authors' work

The results for Czech market are presented in Table 11. From the values of *RCV* it can be concluded that it is a liquid market, which can be proved true if trading volumes were compact and small. Cez and Komercni Banka have the lowest *RCV* indicating liquid stocks, with negative expected return, low risk and large number of trading days. Stocks with higher *RCV* mostly have positive returns and higher risk associated, however it is not a rule.

Table 11
RCV on Prague Stock Exchange

Stock	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
Cez	502	-0,0003	0,0136	0,4768
Komercni Banka	502	-0,0001	0,0194	0,4633
Telefonica Czech	502	-0,0002	0,0109	0,5843
Erste Group	502	-0,0015	0,0255	0,5405
New World Resour	493	-0,0002	0,0307	0,5439
Unipetrol	498	0,0004	0,0136	0,5751
VIG	445	-0,0006	0,0184	1,1359
Philip Morris CR	489	0,0005	0,0141	0,8977
Central European	502	-0,0018	0,0302	0,5813
PEGAS NONWOVENS	479	0,0001	0,0110	0,9342
ORCO PROPERTY	490	-0,0013	0,0272	0,8264
AAA Auto Group	415	0,0005	0,0203	0,8044

Source: Authors' work

Stocks from Poland stock market (Table 12) show much clearer distinction of liquid from illiquid ones when observing *RCV*. Moreover, all stocks but one (KGHM Polska) have negative expected returns in the observed period. Standard deviation is increasing from the first stock in stock index until the last stock in stock index. Therefore it can be concluded that Warshaw Stock Exchange in this period does not show consistent pattern.

Table 12
RCV on Warshaw Stock Exchange

Stock	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
PKO BP	502	-0,0001	0,0197	0,4352
KGHM Polska	502	0,0009	0,0242	0,4026
Pragma Faktoring	429	-0,0002	0,0241	1,1080
INTERSPORT	500	-0,0022	0,0240	1,1763
Skyline Investme	502	-0,0007	0,0297	1,0368
UniCredit	498	-0,0021	0,0284	0,7765
COMPLEX	486	-0,0008	0,0234	1,1211
CASH FLOW	502	-0,0001	0,0374	0,9080
MEDIATEL	468	-0,0035	0,0346	0,9394
WADEX	483	-0,0006	0,0341	1,0010
BELVEDERE	486	-0,0003	0,0403	0,6967
WANDALEX	500	-0,0007	0,0304	1,0271

Source: Authors' work

All stocks from Bulgaria (Table 13) have high values of *RCV* indicating that these stocks have large daily differences in traded volumes. Moreover, this is confirmed by small number of trading days. Standard deviation is increasing from the first stock in stock index until the last stock in stock index and expected return is somewhat positive and somewhat negative.

Table 13
RCV on Sophia Stock Exchange

Stock	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
Spharma	491	-0,0005	0,0124	1,2136
Advance Terrafun	386	-0,0001	0,0172	1,5867
Monbat	487	-0,0003	0,0129	1,3125
Chimimport	487	-0,0007	0,0221	1,0526
Eurohold Bulgari	491	-0,0002	0,0260	1,7118
Stara Planina Ho	456	0,0009	0,0261	1,1828
Fibank	482	-0,0005	0,0223	1,2482
Kaolin	452	-0,0006	0,0234	1,4133
M+Hydraulic	384	0,0008	0,0227	1,4517
BREF	429	0,0012	0,0247	1,5666
Tsentralna banka	491	-0,0010	0,0205	1,0363
IHB	439	-0,0021	0,0255	1,4541

Source: Authors' work

Stocks from Romania stock market (Table 14) have relatively small number of trading days and have both liquid and illiquid stocks. However, half of them are liquid with positive expected returns but high standard deviations, two of them are illiquid with positive expected return and only one stock (Rompetrol) is illiquid and has both negative expected return and high risk. The rest of them have mixed results.

Table 14
RCV on Bucharest Stock Exchange

Stock	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
OMV Petrom	500	0,0005	0,0214	0,1699
BRD-Groupe SG	503	-0,0004	0,0199	0,8530
Alro	445	0,0008	0,0253	1,3163
Transgaz	492	0,0007	0,0189	0,7940
Banca Transilvan	495	-0,0005	0,0229	0,6525
Transelectrca	496	0,0008	0,0235	0,9624
Rompetrol	454	-0,0006	0,0307	1,1425
Azomures	494	0,0026	0,0291	0,9279
Oltchim	491	0,0038	0,0560	0,8513
Zentiva	465	0,0006	0,0266	1,4763
Biofarm	501	0,00003	0,0224	0,9127
Antibiotice	499	-0,0004	0,0233	0,9116

Source: Authors' work

The results of *RCV* prove that Germany stock market (Table 15) is the most liquid of all observed markets. It is followed by the highest number of trading days for all the stocks, low risk measured with standard deviation and small values of expected return.

Table 15
RCV on Frankfurt Stock Exchange

Germany	Number of trading days	Expected return	Standard deviation of expected return	Relative Change in Volume (*RCV*)
SAP	512	0,00067	0,0134	0,3901
K S	512	0,00039	0,0201	0,3696
Heidelberg Cement	512	-0,00067	0,0254	0,3308
Lufthansa	512	-0,00026	0,0203	0,3512
Metro	512	-0,00037	0,0190	0,3554
RWE	512	-0,00146	0,0190	0,3643
Henkel	512	0,00062	0,0152	0,3454
COMMERZBANK	512	-0,00255	0,0285	0,3510
BMW	512	0,00109	0,0220	0,3253
Beiersdorf	512	-0,00002	0,0121	0,3664
Munich Re	512	-0,00028	0,0151	0,3817
Linde	512	0,00069	0,0145	0,3272

Source: Authors' work

It can be seen that the most of observed stocks follow the proposed pattern, i.e. Relative Change in Volume is above 1 for illiquid stocks and below one for liquid stocks. However, in some cases the results are inconsistent. From these findings it can be concluded that *RCV* merits further investigation. It is proved valid in most of emerging market stock exchanges and even on developed stock market like Germany. Therefore this measure should be taken into account when considering illiquidity measurement. Clearly, more serious econometric analysis has to be done to prove the validity of proposed illiquidity measure, primarily in sense of proving impact of illiquidity on stock returns.

Discussion and conclusion

In this paper the problem of illiquidity on emerging markets, using single stock approach, is addressed. Since empirical findings support the assumption that expected returns increase in illiquidity, fulfilling this assumption an illiquidity measure can be considered as valid. Therefore, two most commonly used illiquidity measures, *ILLIQ* and *TURN*, have been discussed, calculated and tested on the sample of seven stock markets. Similarly to the findings of Aitken and Winn (1997), Day (2005), Bekaert et al. (2007), it is shown that this two widely accepted liquidity measures do not drive to equal and/or valid conclusions regarding stock illiquidity performances. Therefore a new illiquidity measure, Relative Change in Volume (*RCV*) is proposed.

This illiquidity measure is appropriate for emerging markets while it captures the main problems on these markets such as infrequent trading and small number of good stocks to be traded with. It has the ability to take into account the pressure of big differences in volume on return which makes it potentially interesting and useful in this global search for unique and valid illiquidity measure in general.

Although RCV gives proper information about the stocks' (il)liquidity for most of observed stocks, in some cases the results are inconsistent. Hence, future research should be conducted to prove the validity of proposed illiquidity measure in general, not only on emerging stock markets, using more serious econometric analysis and different circumstances, which means new time horizons and wider sample of both emerging and developed stock markets.

References

1. Aitken, M.J., Winn, R. (1997), „What is this thing called liquidity?“, Working Paper, Securities Industry Research Centre of Asia-Pacific.
2. Aitken, M., Comerton-Forde, C. (2003), „How should liquidity be measured?", Pacific-Basin Finance Journal, Volume 11, Issue 1, pp. 45–59.
3. Amihud, Y. (2002), „Illiquidity and stock returns: Cross section and time series effects“, Journal of Financial Markets, Volume 5, Issue 1, pp. 31–56.
4. Amihud, Y., Mendelson, H. (1986), „Asset pricing and the bid-ask spread“, Journal of Financial Economics, Volume 17, Issue 2, pp. 223–249.
5. Bekaert, G., Harvey, C.R., Lundblad, C. (2007), „Liquidity and Expected Returns: Lessons from Emerging Markets", Review of Financial Studies, Volume 20, Issue 6, pp. 1783-1831.
6. Chan, H.W. (2005), „Asset Pricing and the Illiquidity Premium“, Financial Review, Volume 40, Issue 4, pp. 429–458.
7. Datar, V.T., Naik, N.Y., Radcliffe, R. (1998), „Liquidity and stock returns: An alternative test“, Journal of Financial Markets, Volume 1, Issue 2, pp. 203–219.
8. Dey, M.K. (2005), „Turnover and return in global stock markets", Emerging Markets Review, Volume 6, Issue 1, pp. 45–67.
9. Ghysels, E., Pereira, J.P. (2008), „Liquidity and conditional portfolio choice: A nonparametric investigation", Journal of Empirical Finance, Volume 15, Issue 4, pp. 679–699.
10. Lischewski, J., Voronkova, S. (2012) „Size, value and liquidity. Do They Really Matter on an Emerging Stock Market?", Emerging Markets Review, Volume 13, Issue 1, pp. 8–25.
11. Minovic, J. Z. (2012), „Liquidity of the Croatian stock market: an empirical analysis", Economic Research, Volume 25, Issue 3, pp. 776-802.

12. Miralles, J.M., Miralles, M.Q., Miralles, J.Q. (2004) „The Pricing of Systematic Liquidity Risk in Stock Markets", Faculdade de Economia, Universidade de Coimbra, issue 20, pp 162-176.
13. Pagano, M. (1989), „Trading Volume and Asset Liquidity", The Quarterly Journal of Economics, MIT Press, vol. 104(2), pp. 255-270.
14. Pastor, L., Stambaugh, R.F. (2001), „Liquidity risk and expected stock returns", NBER Working paper series No. w8462.
15. Vidović, J. (2013), „Investigation of stock illiquidity on Central and South East European Markets in naïve portfolio framework", Economic Thought and Practice, Volume 22, Issue 2, pp. 537-550.

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