SSE Riga Student Research Papers
2015 : 9 (174)

SEASONALITY IN STOCK MARKET LIQUIDITY AND ITS DETERMINANTS

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ISSN 1691-4643
ISBN 978-9984-842-94-3

November 2015
Riga

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Abstract

Seasonality in stock market liquidity refers to significant periodic changes in bid-ask spreads and stock turnover throughout the calendar year. This study analyses three potential determinants: earnings announcements, the degree of financial integration and macroeconomic news announcements, during a five year period by using a sample of 36 financial markets from around the world.

We confirm the previous findings stating that liquidity surges in January and February, and that developed countries experience larger drop in liquidity provision during summer in comparison to developing markets. On average there is a considerable decrease in liquidity provision during the first two weeks after the earnings release date. Our results suggest that more financially integrated countries have greater liquidity fluctuations, while macroeconomic news announcements positively affect liquidity. Generally, our evidence supports all three of the proposed determinants of seasonality.

Keywords: Seasonality, stock market liquidity, earnings announcements, degree of financial integration, macroeconomic news announcements

Acknowledgements

We are very grateful to our thesis supervisor Dr. Tālis Putniņš who guided us throughout the thesis writing process, gave us invaluable pieces of advice, answered all of our questions and provided feedback on our work, which helped us to enhance the level of our study.

We would also like to express our gratitude to Ivan Mihhejev for his help, advice and support. In addition, we would like to thank Emīls Dālderis and Bertrams Pauls Purvišķis for their feedback on our paper and the faculty of the Stockholm School of Economics in Riga for challenging us during our years of study and adding to our personal and professional growth.

Finally, we are truly grateful to our parents for their constant support, advice and genuine willingness to help in all of our commitments and undertakings.

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1. Introduction

The importance of market liquidity cannot be overestimated. It is a fundamental component of the modern financial system, which has received ample amount of attention by researchers. However, it has been noticed and documented that the level of liquidity in the market is not constant over time; rather it follows some seasonal pattern, which raises various questions. What causes markets to be awash with liquidity at certain times? When is the best time to trade in the market? Is there a pattern in liquidity provision? Our research aims to delve into these issues and try to answer the underlying research question: *What are the determinants of seasonality in the stock market liquidity?*

Indeed, existing academic literature lacks clear answers as to why liquidity in the stock markets tends to anomalously increase or decrease in some specific times of the day, week or year, and why it shows regular seasonal pattern. For example, some authors suggest that a significant drop in the trading activity and increase in the bid-ask spreads during summer is attributed towards investors having gone on summer vacation (e.g., Bouman & Jacobsen, 2002; Hong & Yu, 2009), while others (e.g., Chordia, Sarkar, & Subrahmanyam, 2005; Hameed, Kang, & Viswanathan, 2010) show contradicting results and argue that liquidity, e.g., in the U.S. market, tends to increase during the summer months. Despite the fact that there have been some attempts to propose possible explanations for the aforementioned seasonality puzzle, for instance, investors having gone on vacation, tax effects or mutual fund flows, still there are many unanswered questions concerning the determinants of seasonality in the stock market liquidity. Ambiguity in the existing results and lack of clear answers makes us believe that there is a room and need for new evidence.

In order to answer our research question, we use daily stock level data for more than thirty global equity markets for the time period from the 15th of January 2010 till 15th of January 2015. In addition, to structure our approach for finding the answer, we pose three hypotheses, each relating to the potential determinant.

1. *Quarterly accounting earnings announcements are a significant driver of seasonality in stock market liquidity.*

Earnings announcements tend to be published on several predetermined dates during company's accounting year, thus market participants anticipate the occurrence of these events and adjust their trading behaviour. If the vast majority of investors act in a similar fashion, then one can observe considerable changes in overall stock market liquidity.

2. *More integrated financial markets have less pronounced seasonality in liquidity due to smaller impact of idiosyncratic factors and more diversified investors' base.*

We believe that the presence of a broad investors' base in more financially integrated countries should reduce the impact of a country specific factors such as the distance from the Equator, local vacation periods and religious holidays on the degree of liquidity in that financial market. The rationale behind this thinking stems from the presence of investors from abroad, whose trading presumably mitigates the effect of local factors on liquidity provision in a financially integrated market, which allows foreigners to trade without apparent restrictions and realize their trading profits freely. Finally, our third hypothesis deals with the major cyclical macroeconomic news announcements.

3. *Stock market liquidity increases on the day of macroeconomic news announcements.*

The logic behind this potential determinant is similar to the one applied for earnings announcements. Indeed, macroeconomic news announcements tend to be published on a regular basis and are closely monitored by various financial market participants. Some authors consider them to cause fluctuations in the level of market liquidity. Thus we focus on cyclical news announcements, which should affect the provision of liquidity on a regular basis.

According to our results, on average the highest increase in liquidity provision occurs in January and February, while liquidity tends to dry up in summer, which supports findings of Hong and Yu (2009). Moreover, we find that both developed and developing countries exhibit similar decline in the summer period. Tests for the first hypothesis indicate that 23 out of 36 countries have significant earnings season dummies. There is a considerable drop in liquidity during the first two weeks after the earnings release date, which is followed by recovery during the second half of the month. This means that the presence of financial reporting period induces seasonality in liquidity provision by traders. Next, findings for the integration determinant are mixed, depending on the choice of the liquidity measure. For instance, when we use relative spreads as our liquidity measure, then integration has positive effect on seasonality in the stock market liquidity, while usage of turnovers leads to opposite conclusions. We explain this result with relative spreads and turnovers representing different liquidity dimensions. Indeed, relative spreads are more intuitively appealing measure of liquidity, because higher bid-ask spreads (lower liquidity) increase transaction costs and consequently diminish the demand for particular securities (Sarr & Lybek, 2002). Turnover, on the other hand, can be more described as a measure of the market activity. Fong, Holden and Trzcinka (2014) claim that performance of different liquidity proxies differs across markets and over time. They indicate that various liquidity measures are not perfect substitutes to each other and thus should not be treated as ones. Finally, the effect of

macroeconomic news announcements on the whole sample of tested countries illustrates that all four types of chosen news announcements (consumer price index, producer price index, gross domestic product and employment rates) have mainly positive and significant explanatory power.

Our work contributes to the existing literature in several ways. Firstly, we test seasonality in the stock market liquidity rather than in stock returns in both advanced and emerging markets. Indeed, the vast majority of available papers either looks at seasonality in returns or puts a significant emphasis on the U.S. market (Draper & Paudyal, 1997), thus often neglecting other countries. Secondly, we propose new determinants that could explain seasonality in the stock market liquidity. As stated before, existing empirical evidence lacks clear answers as to what causes seasonal patterns in the financial markets, thus we try to fill in the gap in the current findings. Thirdly, we summarize already documented studies and add new evidence that can serve as a useful material for future works in this area. Finally, our paper has practical implications for those investors who follow and apply seasonal trading strategies. For example, Burton (2010) argues that timing of investment matters. Even though some sceptics consider seasonal trading strategies being close to astrological nonsense, others have reaped monetary gain. Our work shows seasonality patterns in various groups of countries and can help to make better investment decisions.

The paper is organized in the following way. Section 2 gives an overview of literature devoted to seasonality in liquidity. Section 3 provides data description. Section 4 develops methodology and presents robustness checks. Sections 5 and 6 analyse and discuss the results, while Section 7 concludes.

2. Literature review

In this section we present theoretical framework and review the relevant empirical evidence on seasonality in liquidity, as well as touch upon some liquidity determinants that have been proposed in previous research and might affect appearance of seasonal patterns in market wide liquidity. We show the controversial nature of this topic and ambiguity in the existing findings. Furthermore, we proceed with the description of our chosen determinants, which are outlined in the hypothesis, and give theoretical reasoning for our choice.

Before moving further, it is worth mentioning that we define *seasonality in the stock market liquidity* as significant changes in the market liquidity provision (e.g., narrower bid-ask spreads, larger share turnover) during the calendar year on a regular basis.

2.1. Seasonality in stock market liquidity

To start with, the literature on seasonality in liquidity is rather scarce. There are many papers exploring seasonality in stock returns, which mainly concentrate on calendar effects (e.g., the so-called January effect) or size effects (e.g., excess returns of small companies); however, only few works have looked at the stock market seasonality in liquidity, and those that have, usually concentrate on the U.S. market (Draper & Paudyal, 1997).

2.1.1. Month-of-the-year effect

In their paper Hong and Yu (2009) study 51 stock exchanges around the globe and find that stock turnover in summer is considerably lower by approximately 7.9%. In addition, cost of trading (in the form of wider bid-ask spreads) is higher in comparison to other seasons of the year, which authors explain with investors having gone on vacation and an overall decrease in financial markets' economic activity. The authors indicate that gained results are particularly strong for European and North American stock markets, where one can observe a decline in stock turnovers by 15.8% and 13.5% respectively. They report that among 10 biggest financial markets, drop in the overall trading activity is around 12.9%, while it is only 6.7% for the rest of their sample countries. This indicates that the effect of seasonality is nearly twice as large in advanced markets in comparison to the rest of the world. Bouman and Jacobsen (2002) also use proxies for vacation to check if trading activity decreases during summer; their results imply that it does.

On the other side, Chordia et al. (2005) and Hameed et al. (2010) study the U.S. market. The former authors claim that liquidity is at its peak during mid-summer till early autumn; this fact is also supported by the findings of the latter paper. Indeed, Hameed et al. (2010) document that liquidity in the markets increases during the time from May till

September in comparison to any other months, which is expressed with narrower bid-ask spreads during this time of the year.

2.1.2. Day-of-the-week effect

Apart from the month-of-the-year effect, there are several papers that look at the day-of-the-week effect in seasonality in liquidity, meaning that they try to determine whether markets are more or less liquid on some certain days of the week. Indeed, Hameed et al. (2010) document that bid-ask spreads are larger (i.e. market is less liquid) during Fridays and around holidays, which is also consistent with the findings of Chordia et al. (2005) who observe the same results. In addition, the latter paper claims that the liquidity of stock market is at its highest at the beginning of the week. More precisely, in their earlier work Chordia, Roll and Subrahmanyam (2003) emphasize that trading activity and liquidity are at their peak during Tuesdays relative to other days. However, Foster and Viswanathan (1993) find that trading volume is the lowest, and bid-ask spreads are the widest (Rubio & Tapia, 1996) on Mondays, which contradicts the results of Chordia et al. (2005) and Hameed et al. (2010), thus, creating another ambiguity in the existing empirical evidence.

The contradicting findings of the two streams of aforementioned articles make us believe that there is a room for another study which would analyse seasonality in stock market liquidity across various markets and help reconcile this puzzle. In addition, existing literature lacks a clear answer as to what causes seasonality in the stock market liquidity. While several papers have proposed possible explanatory variables (some of which are listed below), very little is known about the determinants of seasonality in the stock market liquidity. Consequently, there is a need for more extensive research in this field.

2.2. Determinants of seasonality in liquidity

As mentioned before, Hong and Yu (2009) apply a proxy for vacation in order to explain seasonal trends in liquidity. Apart from a summer dummy, they also collect data for monthly airline passengers and hotel occupancy rates, which, to their mind, should be an indicator of the amount of country's residents having gone on vacation. Authors give two explanations that might cause different magnitudes of gained results across regions (e.g., stronger seasonality effect in Europe and North America). Firstly, it might be due to cultural or religious differences, e.g., summer vacation is like a social norm in Europe. Secondly, it seems that there are stronger seasonality patterns for regions that are further away from the Equator, because those areas experience greater difference in weather conditions, and people who live there are prone to having vacation preference during some specific time of the year.

Furthermore, another cause could be tax-loss selling proposed by Draper and Paudyal (1997), which assumes that investors want to realise capital losses at the end of the year. This is closely related to the so-called window dressing practices and manipulation with closing stock prices by managers of mutual funds, in order to enhance their performance indicators. We choose not to address the abovementioned potential factors in our research due to the data availability issues, since the information regarding the trading activity of institutional investors remains undisclosed in a lot of markets. Finally, there might be behavioural reasons (e.g., changes in investor mood over the week, Seasonal Affective Disorder (SAD) arising from decreased daylight hours from mid-autumn till mid-spring) that could result in systematic seasonal patterns in trading activity (Chordia et al., 2003; Kamstra, Kramer, & Levi, 2003).

In the following subsections we propose other possible determinants of seasonality in stock market liquidity and support each topic with relevant literature.

2.2.1. Earnings announcements

Earnings announcements can be considered as one of the most important events in every company's financial life (Nikiforov, 2008). There are few works that have looked at the market level frictions around earnings announcements (e.g., Donders, Kouwenberg, & Vorst, 2000; Lee, Mucklow, & Ready, 1993) and which show that in majority of cases trading volume increases during the period of earnings announcement, and reaches its peak on the respective day of the event (Donders et al., 2000; Gajewski, 1999). However, the impact of earnings announcements on bid-ask spreads is mixed. Some of the proposed explanations for these observations are adverse selection and information asymmetry (Rubio & Tapia, 1996). Indeed, there seem to be two streams of findings (Krinsky & Lee, 1996). The first one shows that bid-ask spreads become larger and depth drops before the earnings announcements (Easley & O'Hara, 1992; Lee et al., 1993), which can be seen as protection of market makers versus informed traders who might possess superior information prior to the event. The second type of results, which was firstly raised by Kim and Verrecchia (1994), indicates that liquidity tends to decrease (in the form of wider bid-ask spreads and drop in the market depth) during and right after the announcement. These authors imply that earnings announcements can be seen as noisy signals, and that insiders are better at understanding and interpreting information they contain.

Both instances illustrate that some individuals tend to be better informed (e.g., company managers) and thus be able to make wiser investment decisions and trade on knowledge. This makes liquidity providers charge higher fee on every transaction in order to

compensate expected losses from the deals with informed traders via gaining profit from the so-called “noise” traders (Donders et al., 2000).

In general, it can be argued that earnings announcements follow seasonal pattern, they are highly predictable and are anticipated by the market participants (Lee et al., 1993), thus it might be a strong determinant for seasonality in stock market liquidity. Despite the fact that quite many works touch upon the subject of earnings announcements, and some papers like Lamont and Frazzini (2007) or Heston and Sadka (2008) propose earnings announcements as a possible explanatory variable for seasonality in trading activity, to our knowledge, none of the existing literature has examined the extent to which seasonality in stock market liquidity can be attributed to the earnings announcements. Thus we would like to test the following hypothesis:

H1: Quarterly accounting earnings announcements are a significant driver of seasonality in stock market liquidity.

The earnings announcements bear either positive or negative signal to the investors depending on the market expectations and real situation with regard to the amount of profit or loss a company has generated. Despite the fact that some firm announcements might considerably affect the provision of liquidity in the whole stock market, others can have either no or negligible influence. We expect that on average earnings announcements should cause significant changes in the provision of liquidity in the particular market during the chosen earnings reporting period. This should happen not only due to the significance of the information that this type of announcement carries, but also because of the fact that many companies tend to publish their results at the same time span and thus there is increased uncertainty and consequently seasonal liquidity shifts in the whole stock market.

At the same time, it is important to note, that there are different types of earnings announcements. For example, Rubio and Tapia (1996) or Koski and Michaely (2000) look at dividend announcements; Lee et al. (1993) and Venkatesh and Chiang (1986) look at both dividend announcements and release of financial results, while Morse and Ushman (1983) and Skinner (1991) examine accounting earnings release. In order to test the above hypothesis, we are also going to look at quarterly accounting earnings announcements (release of financial statements) in specific markets. It is interesting that Morse and Ushman (1983) report no effect on quoted spread from earnings announcements, while Gajewski (1999) and Skinner (1991) show widening of spreads after the announcements which is explained by the existence of the so-called earning surprise. Generally, existing evidence of

the effect of earnings announcements on the market liquidity is inconclusive (Chung and Li, 2003; Donders et al., 2000), thus motivating more research in this field.

Furthermore, although Lee et al. (1993) indicate that the major changes in liquidity occur in a few hour or day intervals around earnings announcements, Nikiforov (2008) describes the so-called earnings season, which can be defined as the month that is exactly following the quarterly release of accounting earnings, and which might lead to considerable changes in liquidity. The author examines seasonality in returns and liquidity risk, yet also mentions that little has been done in order to see how aggregate earnings announcements affect overall market during some specific time frame. He adds that intra-industry information transfers indicate that during 'earnings season' there might be a market wide drop in the liquidity, as well as that trading volume (share turnover) should increase throughout this time period.

2.2.2. Degree of financial integration

Financial integration is a broad term, which can be defined as co-movements of the equity markets over time (Neaime, 2002). The studies devoted to integration of financial markets used to focus primarily on developed countries (Arshanapalli & Doukas, 1993; Kasa, 1992; Kim & Wadhani, 1990). Half a decade later developing countries also sparked the attention of researchers. For instance, Schwert and Seguin (1990) attempted to capture time variation in market risk by estimating local and global betas. This approach was later used by Yue Nan Wang (2007) in the Chinese A share market, who determined that it did not become closer linked with the global market over the period 1995 to 2002. Bekaert and Hodrick (1992) discovered that emerging markets provided predictable above average returns, which were not strongly correlated with the movements of the major financial indices and consequently offered great diversification benefits. Bekaert and Harvey (2000) employed an asset-pricing model in order to estimate the period, when the stock exchanges in developing markets started integrating into the global market. In general, it is believed that returns in perfectly integrated financial markets should be explained only by global systemic risk already incorporating some local market risks and thereby leaving no space for pure idiosyncratic risk, which is diversified away due to stronger country's ties with other financial markets (Wang, 2007) and more international investor base. Applying the same logic in a context of liquidity we raise the following hypothesis:

H2: More integrated financial markets have less pronounced seasonality in liquidity due to smaller impact of idiosyncratic factors and more diversified investors' base.

The reasoning behind it is as follows. Current studies, including ours, advocate the existence of seasonality in liquidity in a certain financial market to idiosyncratic factors of that market such as vacation days of investors (Hong & Yu, 2009), tax-loss selling hypothesis (Draper & Paudyal, 1997) and other cultural, religious and geographical factors predominant in each market. Since investors' base in more financially integrated markets is represented not only by the citizens of that country, but also by individual and corporate investors from abroad (Martell & Stulz, 2003), country specific factors affecting the stock market are expected to diminish, thereby reducing the level of seasonality in liquidity in that market. We can assume that a more financially integrated country has a more diverse investor base, which should result in less pronounced degree of seasonality in liquidity in that financial market. To our knowledge the abovementioned hypothesis has never previously been raised in the existing literature. We further elaborate on it in the methodology section.

2.2.3. Macroeconomic news announcements

Macroeconomic news announcements are frequently happening events, which might considerably affect market wide liquidity, thus they are monitored by traders, economists, investors, financial press and other interested parties (Tham, 2008). Several authors have proposed macroeconomic announcements to cause changes in market liquidity. For example, Chordia et al. (2003) examine the U.S. stock market and test how macroeconomic announcements, specifically, announcements about the unemployment rate, gross domestic product (GDP) and consumer price index (CPI) influence time-series behaviour of market liquidity. They find that both trading activity and depth increase before the GDP and unemployment news, while there are no significant liquidity changes around CPI announcements. Tham (2008) looks at the effect of macroeconomic news announcements on liquidity in Foreign Exchange market and illustrate that there is a significant drop in liquidity following the news release due to the increase in information asymmetry at that time period.

Moreover, existing research pinpoints that trading activities of High Frequency (HF) traders are strongly interrelated with flows of public information, including macroeconomic news announcements (Brogaard, Hendershott, & Riordan, 2013). Jiang, Lo and Valente (2013) show that before the news announcement, HFT negatively affects market liquidity, while after the announcement, HFT contributes to narrowing of bid-ask spreads and thus enhances liquidity. Given, that nowadays a substantial share of trades in many financial markets is executed by HFT (according to Philips (2013), in the U.S. more than 60% of trades were made by HFT from 2008 till 2011, and 50% in 2013), and that non-HFT traders

also might follow major macroeconomic indicators, we can speculate that macroeconomic news announcements might lead to considerable changes in stock market liquidity.

Furthermore, we can argue that macroeconomic news announcements follow seasonal pattern, because, for instance, many macroeconomic indicators are calculated and released on a quarterly basis (OECD, n.d.), thus it is worthwhile examining whether it could be considered as one of the determinants for seasonality in stock market liquidity. Consequently, we state the third hypothesis:

H3: Stock market liquidity increases on the day of macroeconomic news announcements.

3. Data

Our dataset comes primarily from Datastream. We collect the information on daily bid-ask spreads, stock prices, trading volume and number of shares outstanding for a sample of 100 randomly selected stocks in each financial market for the period from 15th January 2010 to 15th January 2015. The selected stocks should have a trading period longer than a year for regression specifications. The advantage of including 100 randomly selected stocks from each market with a few exceptions, such as the Baltic countries which have less publicly listed firms, is that it allows us to treat each market equally. By limiting the number of studied stocks we are able to identify and select an equal number of shares from both developed and developing markets in our sample without facing the need to constrain our sample by including only the countries with highly liquid stock exchanges.

The sample contains 35 financial markets across such regions in the world as Asia, North America, South America, Europe and Oceania plus the Baltic region countries (i.e., Estonia, Latvia and Lithuania), which, due to the small number of publicly listed firms, are combined into one market. Countries are chosen based on the availability of stock level data. After picking the countries, we focus on the largest and most liquid stock exchanges in every market, e.g., NYSE in the USA, LSE in the UK and so on, since we expect that the largest stock market should be a better representation of all firms listed in the particular country.

In addition, to test the impact of the news announcements, we use data from the Central Intelligence Agency's (2013) World Factbook for all countries fiscal year end dates, which are used to construct variables for testing the first hypothesis. Next, we manually find the dates for four macroeconomic news announcements: employment (including unemployment), consumer price index (CPI), producer price index (PPI) and gross domestic product (GDP). Our choice of macroeconomic factors is based on such papers as Birz and Lott (2011), Chordia et al. (2003) or Rangel (2011) which find that the aforementioned parameters are followed by investors and might affect the market wide liquidity. The third hypothesis is tested on twelve financial markets: Australia, Canada, Finland, Germany, Hong Kong, Italy, Japan, New Zealand, Sweden, Switzerland, the United Kingdom and the USA, which are chosen based on the availability of all the necessary data. Information is obtained from the statistical bureaus of each country. Finally, to measure the degree of financial integration for each market, we collect the data for local market indices and MSCI World index from Datastream, while daily US treasury bills' yields (proxies for the risk free rates) are obtained from the US Department of Treasury.

4. Methodology

To study the determinants of seasonality in the stock market liquidity across numerous financial markets over specific period of time, we employ panel data. Majority of panel data characteristics are the same as for the cross-sectional design (e.g., many cases of the study and multiple variables); but panel data accounts for changes over time (Bryman, 2004). To account for potential sample attrition bias, we disregard those stocks that have less than one year of observations.

It has to be noted that at some certain steps of our analysis, for instance, performing robustness check for the second hypothesis, apart from the time dimension we also look at the purely cross-sectional dimension of the analysis. Consequently, in addition to the panel data, we employ cross-sectional research design.

4.1. Liquidity measures

One can divide liquidity measures into four groups: (a) *transaction cost measures* that try to incorporate costs that arise from trading financial assets and estimate tightness; (b) *volume based measures* that concentrate on the transactions' volume in the market and usually are used to determine depth and breadth; (c) *equilibrium-based measures* that mainly estimate resiliency; and (d) *market-impact measures* that attempt to measure speed of price discovery, as well as resiliency (Sarr & Lybek, 2002). It has to be noted, that there is no one universal measure that captures all dimensions of market liquidity (i.e., tightness, depth, breadth, resiliency and immediacy).

In order to assess seasonality in the stock market liquidity, we are going to use two liquidity measures: *relative spread* and *turnover*. Our choice is based on the data availability, the fact that these two measures together cover three liquidity dimensions and papers by, for example, Fong, Holden and Trzcinka (2014) or Sarr and Lybek (2002), who consider these proxies as reliable measures for determining the financial market liquidity. We apply the same method as Rubio and Tapia (1996) and calculate the former measure for each stock in every country by using the following formula:

$$\boldsymbol{Relative\ Spread_{it}} = \frac{ASK_{it} - BID_{it}}{(ASK_{it} + BID_{it})/2} \quad (1)$$

where ASK_{it} and BID_{it} denote the quoted ask and bid prices for stock i on day t. Furthermore, the relative spread, which is also sometimes referred to as a percentage spread, belongs to transaction cost liquidity measures, which implies that a particular spread would be less costly if the price was higher. Relative spread is suitable for drawing comparisons across

markets (Sarr and Lybek, 2002), which is important in our study, as we intend to examine the seasonality in liquidity in various financial markets.

In order to assess seasonality in market liquidity from the perspective of changes in trading activity, we are going to calculate the second liquidity measure $\boldsymbol{Turnover_{it}}$ based on Hong and Yu (2009) and Rubio and Tapia (1996) papers. It is calculated for each country in the following way:

$$\boldsymbol{Turnover_{it}} = \frac{Number\ of\ shares\ traded_{\ it}}{Number\ of\ shares\ outstanding_{\ it}} \quad (2)$$

where *i* is the subscript for some particular stock, while *t* denotes specific time period (in our case day).

Turnover belongs to volume based measures, and it gives an idea about how many times some particular asset's outstanding volume changes hands (Sarr and Lybek, 2002).

4.2. Earnings season measure

In order to test the effect of earnings announcements on seasonality in stock market liquidity, we construct a proxy for earnings seasons. Based on the method by Lamont and Frazzini (2007), we collect historical fiscal year end dates in the particular market from which we derive respective quarter ends. We obtain this information from the Central Intelligence Agency's (2013) World Factbook. Next, we determine the earnings season. For instance, if the fiscal year terminates at the end of December, then the respective earnings seasons are January, April, July and October. Once we have identified the earnings seasons, we create a dummy variable ES_{ct} (earnings season for a country *c* on day *t*), which takes a value of 1 in case if the stock day observation falls in the earnings season and 0 otherwise.

It has to be noted that in accordance with the findings of Nikiforov (2008) our dummy variable ES_{ct} is not based on the whole earnings season month, rather we test two instances: (a) when ES_{ct} represents the first fourteen days (first two weeks) of each new quarter or (b) ES_{ct} takes the value 1 during the third and the fourth week of each new quarter (the peak of the earnings season) and 0 otherwise. We chose this approach, because Nikiforov (2008) documents significant drop in trading volume if one applies case (a) and considerable increase in trading volume in case (b). According to the latter author, using the whole earnings season month generates insignificant results.

Furthermore, Lamont and Frazzini (2007) indicate that looking at fiscal year ends is a rather accurate method to build proxies for quarter year ends. It is also easier to collect the needed dates in comparison to specific announcement dates, which are only available via particular databases (e.g., Compustat).

4.3. Degree of financial integration measure

In order to construct our financial integration measure, we employ the model of partially integrated CAPM discussed by Jorion and Schwartz (1986). First, we need to find the component of the domestic index that is independent of the global market index, thus we run the following time-series regression for each country:

$$r_{mt}^{D} - r_{ft} = \alpha_0 + b_t(r_{mt}^{G} - r_{ft}) + \upsilon_t^{D\perp G} \quad (3)$$

where r_{mt}^{D} is the return on the specific country's domestic market index on day *t*, r_{ft} is the risk-free rate and r_{mt}^{G} is the return on the global market index on day *t*, where the global index in our paper is the MSCI World Index; b_t is the sensitivity of domestic market returns to the global market returns, and $\upsilon_t^{D\perp G}$ is the orthogonal component. Afterwards we save the values of the residual $\upsilon_t^{D\perp G}$ as an independent variable, which is applied in the next country by country regression:

$$r_{it} - r_{ft} = \alpha_i + \beta_i^{G}\left(r_{mt}^{G} - r_{ft}\right) + \beta_i^{D\perp G}\upsilon_t^{D\perp G} + \varepsilon_{it} \quad (4)$$

where α_i is the fixed effects dummy for the asset *i*, r_{it} is the return on stock *i* on day *t*, while β_i^{G} and $\beta_i^{D\perp G}$ are asset's *i* sensitivity towards global index excess return and domestic orthogonal residual $\upsilon_t^{D\perp G}$ respectively; ε_{it} is the error term.

We use $\beta_i^{D\perp G}$ to construct our financial integration measure. The condition for the full market integration is $\beta_i^{D\perp G}$=0, meaning that in fully integrated market individual country's domestic risk should not be priced. Given that in majority of cases $\beta_i^{D\perp G}$ values in our results are positive; we construct our integration measure via changing the sign before the coefficient:

$$\widehat{\boldsymbol{Integration}}_{\boldsymbol{i}} = -\,\beta_i^{D\perp G} \quad (5)$$

This is done in order to be able to interpret this measure in the following manner: the higher is the value of $\widehat{\boldsymbol{Integration}}_{\boldsymbol{i}}$ (the closer it is to 0), the more integrated some country's stock is.

The aforementioned integration measure $\widehat{\boldsymbol{Integration}}_{\boldsymbol{i}}$ is used in performing cross-sectional regressions (the first robustness check), thus omitting any time variation in the variables. Nevertheless, in order to obtain more robust results, for our main analysis we adjust the partially integrated CAPM model and perform rolling regressions to get time-varying coefficients. More precisely, we retain equation (3) unchanged, while we start with adjusting county by country regression (4) in the following manner:

$$r_{it} - r_{ft} = \alpha_i + \beta_{i\tau}^{G}\left(r_{mt}^{G} - r_{ft}\right) + \beta_{i\tau}^{D\perp G}\upsilon_t^{D\perp G} + \varepsilon_{it} \quad (6)$$

where $\beta_{i\tau}^{G}$ and $\beta_{i\tau}^{D\perp G}$ are time-varying coefficients obtained from rolling regressions. These coefficients are calculated as the averages of the daily beta values for a 261 day (1 year) windows, where each next window starts after a 30 day (1 month) lag. For example, if the first $\beta_{i\tau}^{G}$ is calculated using the whole year 2010, then the second coefficient is calculated dropping January 2010 from the first window and adding January 2011. Here τ denotes the time unit that is the sequence of the rolling regression windows, starting from the earliest, which begins in 2010, till the latest, which ends in the early 2015. We use $\beta_{i\tau}^{D\perp G}$ to construct our time-varying integration measure:

$$\widehat{\boldsymbol{Integration}}_{i\tau} = -\beta_{i\tau}^{D\perp G} \quad (7)$$

Here the interpretation of the integration measure mirrors the one for the equation (5). The closer the $\widehat{\boldsymbol{Integration}}_{i\tau}$ measure is to 0, the more integrated particular country's stock *i* is. The only difference is the fact that we allow $\widehat{\boldsymbol{Integration}}_{i\tau}$ changing over time, and thus we are able to employ panel regressions, which will be described in greater detail in the econometric design section.

4.4. Macroeconomic news announcements

In order to test the effect of macroeconomic news announcements on seasonality in the stock market liquidity, we use information from twelve financial markets, i.e., Australia, Canada, Finland, Germany, Hong Kong, Italy, Japan, New Zealand, Sweden, Switzerland, the United Kingdom and the USA. We chose these countries based on the availability of all the necessary data. It is also worth noting that Australia, Canada, Germany, Hong Kong, Japan, Switzerland, the UK and the USA are part of the top 10 strongest financial markets in the world (Liu & Reinhardt, 2012). Finding a significant effect of macroeconomic news announcements on seasonality in liquidity in large and well diversified markets would illustrate the importance of this particular determinant.

The specific macroeconomic variables that we have chosen are employment (including unemployment), consumer price index (CPI), producer price index (PPI) and gross domestic product (GDP). We construct dummy variables for each announcement (D_{CPIt}, $D_{Employment,t}$, $D_{PPIt,}$ D_{GDPt}), where the dummy takes the value of 1, if the news appears on a specific day and value 0, if there is no news on that respective day.

4.5. Econometric design

4.5.1. Earnings and macroeconomic news announcements

Due to the similar approach of constructing and testing earnings and macroeconomic news announcements, we describe the econometric design for both determinants under the same subsection. Here we follow the idea of Hong and Yu (2009); however, instead of employing dummy variables for seasons of the year, we apply dummies for each respective month of the year. Thus for both the first and the third hypothesis we run stock level panel regressions for each country, which are presented below:

$$log(\boldsymbol{Liquidity\ measure_{it}}) = \alpha + b_1 D_{jan\ t} + \ldots + b_{11} D_{nov\ t} + z_1\, D_{GDP,t} + z_2\, D_{CPI,t} + z_3\, D_{PPI,t} + z_4\, D_{Employment,t} + \varepsilon_{it} \quad (8)$$

or

$$log(\boldsymbol{Liquidity\ measure_{it}}) = \alpha + b_1 D_{jan\ t} + \ldots + b_{11}\, D_{nov\ t} + z_5\, ES_{ct} + \varepsilon_{it} \quad (9)$$

where the $\boldsymbol{Liquidity\ measure_{it}}$ is either $\boldsymbol{Relative\ Spread_{it}}$ or $\boldsymbol{Turnover_{it}}$ for each stock *i* on day *t*; $D_{jan\ t}$ ... $D_{nov\ t}$ are dummy variables which take the value of 1 if observation falls on the day of each respective month, D_{GDP}, D_{CPI}, D_{PPI}, D_{Empl} are dummy variables for macroeconomic news announcements, while ES_{ct} denotes earnings season's dummy variable for a country *c*; b_1 through b_{11} and z_1 through z_5 are respective sensitivities of factors, and ε_{it} is the error term.

4.5.2. Financial Integration

In order to test the second hypothesis about the degree of market's financial integration, we proceed in two steps. Each step is done for the panel regressions.

Stage 1

Once we have obtained our time-varying integration measure $\widehat{\boldsymbol{Integration_{i\tau}}}$ from the equation (7), we construct the time-varying seasonality measure. The authors of this paper apply similar idea to the one by Hameed et al. (2010); however, we specify the following type of rolling stock-day country by country regressions:

$$\boldsymbol{Liquidity\ measure_{it}} = \alpha_i + b_{1\tau}\, D_{jan\ t} + b_{2\tau}\, D_{feb\ t} + \ldots + b_{11\tau}\, D_{nov\ t} + \varepsilon_{it} \quad (10)$$

where α_i is the intercept for stock *i*, ε_{it} is the error term and τ is our time unit, which represents rolling window sequence. In this regression we specify, obtain and save time-varying R^2 values for each stock *i*, where each R^2 value is calculated for a 261 day (1 year) time span and every next value is calculated by moving the regression window by 30 day (1 month) period. These R^2 values are used to construct our time-varying seasonality measure:

$$\widehat{\boldsymbol{Seasonality_{i\tau}}} = R^2_{i\tau} \quad (11)$$

Stage 2

After obtaining time-varying integration and seasonality measures, we build a panel, which consists of $\widehat{\boldsymbol{Integration}}_{i\tau}$ and $\widehat{\boldsymbol{Seasonality}}_{i\tau}$ measures for all sample countries and their respective stocks. Next, we run the final step of the integration analysis, which is represented by the following panel regression:

$$\widehat{\boldsymbol{Seasonality}}_{i\tau} = \alpha_i + \beta\, \widehat{Integration}_{i\tau} + \varepsilon_{i\tau} \quad (12)$$

where β is the sensitivity of seasonality to integration, τ represents our time unit, which is the sequence of the rolling regression windows, where each new window is 261 days long and starts after 30 day lag with respect to the previous window.

Additional analysis

In addition to the above analysis, we want to test not only the effect of integration on the level of seasonality in the stock market liquidity, but also simultaneously take into account the influence of earnings announcements on the level of seasonality in the stock market liquidity. Here we disregard macroeconomic news announcements, because they are not tested on all countries from our full sample, but rather only on one third (12 countries). Consequently, we run the following type of regression:

$$\widehat{\boldsymbol{Seasonality}}_{i\tau} = \alpha_i + \beta\, \widehat{Integration}_{i\tau} + e\, Earnings_{i\tau} + \varepsilon_{i\tau} \quad (13)$$

where $Earnings_{i\tau}$ includes one to four earnings season variables (described further), while β and e are respective sensitivities of both factors.

Earnings variables

In equation (13), we cannot directly use our earnings season dummy ES_{ct} per se, because here we need the effect of earnings announcements on the level of liquidity. This effect is captured by the coefficient z_5 before the earnings season dummy in equation (9). Thus we need to build additional earnings announcement variables $Earnings_{i\tau}$ via using the equation (9). Moreover, we have to ensure that z_5 is time varying, in order to gain consistency among the time units in equation (13). Thus we run the following rolling country by country regression for each stock:

$$\boldsymbol{Liquidity\ measure}_{it} = \alpha + b_{1\tau} D_{jan\,t} + \ldots + b_{11\tau} D_{nov\,t} + z_{5i\tau}\, ES_{ct} + \varepsilon_{it} \quad (14)$$

where $z_{5i\tau}$ is our time-varying effect of earnings announcement on seasonality in the stock market liquidity for each stock i at time τ, where the time unit τ represents the sequence of rolling windows. Eventually, we save the values of $z_{5i\tau}$ and construct four earnings variables:

- *Earnings_1* where the liquidity measure is $\boldsymbol{Relative\ Spread}_{it}$ and ES_{ct} represents the first and second week of the earnings season;

- *Earnings_2* where the liquidity measure is $\boldsymbol{Relative\ Spread_{it}}$ and ES_{ct} represents the third and fourth week of the earnings season;
- *Earnings_3* where the liquidity measure is $\boldsymbol{Turnover_{it}}$ and ES_{ct} represents the first and second week of the earnings season;
- *Earnings_4* where the liquidity measure is $\boldsymbol{Turnover_{it}}$ and ES_{ct} represents the third and fourth week of the earnings season.

4.6. Robustness check

4.6.1. Earnings and macroeconomic news announcements

Due to similarity in testing approach, the robustness check for earnings and macroeconomic announcements is the same. We drop the month of January in the original equations (8) and (9) with an intention to test the sensitivity of our results to the presence of extraordinary trading activity during the respective month.

Our concern is that our results might be influenced by the so-called January effect, which is believed to be associated with higher stock returns and more active trading in January due to the tax-loss selling incentives of investors at the end of a previous financial year (Dyl, 1977; Reinganum, 1983). Tax-loss selling hypothesis states that investors sell the stocks of depreciating small companies in December, in order to reduce taxable income, and in the next month the price returns to its fundamental value due to the elimination of selling pressure. The effect was documented not only in the USA, but also in other financial markets around the globe, some of which even did not enact the legislation for capital gains taxes or had different dates for financial calendar (Reinganum & Shapiro, 1987; Van den Bergh & Wessels, 1985). Thereby, to ensure that our results are not heavily affected by January effect, we exclude the month of January observations as part of our robustness checks.

4.6.2. Financial integration

In order to cross-check the results which are obtained from the main analysis of the degree of market's financial integration, we employ two robustness checks.

First robustness check

Here we adjust the model of our main analysis. Instead of having time-varying parameters, we look at purely cross-sectional dimension. Once we have obtained our static integration measure $\boldsymbol{\widehat{Integration}_i}$ from equation (5), we construct the seasonality measure. We apply the same idea as in equation (10) proposed by Hameed et al. (2010); yet here we run the following type of stock-day country by country regressions:

$$\boldsymbol{Liquidity\ measure_{it}} = \alpha_i + b_1 D_{jan\,t} + b_2 D_{feb\,t} + \ldots + b_{11} D_{nov\,t} + \varepsilon_{it} \qquad (15)$$

where α_i is the intercept for stock *i*, and ε_{it} is the error term. From this regression we obtain and save one R^2 value for each stock *i* in country *c*, which are used in order to construct our seasonality measure $\widehat{\boldsymbol{Seasonality}_i}$. This measure is applied to perform purely cross-sectional analysis, where we use all sample stocks from all countries and run the following stock level regression:

$$\widehat{\boldsymbol{Seasonality}_i} = \alpha_i + \beta\, \widehat{Integration}_i + e\, Earnings_i + \varepsilon_i \quad (16)$$

where $\widehat{Integration}_i$ is our integration measure for stock *i* constructed in equation (5). $Earnings_i$ includes four earnings announcement variables, β and e are respective sensitivities of both factors. Earnings variables are obtained from the following stock by stock regressions:

$$\boldsymbol{Liquidity\ measure_{it}} = \alpha + b_1 D_{jan\,t} + \ldots + b_{11} D_{nov\,t} + z_{5i}\, ES_{ct} + \varepsilon_{it} \quad (17)$$

where we obtain and save one z_{5i} value for each stock *i* (i.e. getting 100 values for one financial market). The interpretation of the earnings variables is the same as under the main analysis with the only difference being that in the first robustness check earnings variables are not time-varying.

Second robustness check

The second robustness check is an additional step in partially integrated CAPM by Jorion and Schwartz (1986). Here we need to save the values of $\beta_{i\tau}^{G}$ and $\beta_{i\tau}^{D\perp G}$ obtained in regression (6) in order to use them as explanatory variables. Consequently, we perform the following type of country by country regression:

$$(r_{it} - r_{ft})_{i\tau} = \alpha_i + \lambda_1\, \beta_{i\tau}^{G} + \lambda_2 \beta_{i\tau}^{D\perp G} + \varepsilon_i \quad (18)$$

where $(r_{it} - r_{ft})_{i\tau}$ is the excess return on a specific country's stock *i* for the period τ. Indeed, in order for the number of dependent and independent variables to match, we calculate the average values for the daily excess stock returns, where the window is 261 days and each new window starts after 30 days (just the same as for the explanatory variables). $\lambda_1$and λ_2 are coefficients of previously obtained $\beta_{i\tau}^{G}$ and $\beta_{i\tau}^{D\perp G}$ variables. Here λ_2 is used to build our control (robustness check) integration measure for each country *c*:

$$\widehat{\boldsymbol{IntegrationRobustness}_c} = -\lambda_2 \quad (19)$$

In the same fashion as for $\beta_{i\tau}^{D\perp G}$, the condition for full market liberalization is λ_2=0, which also implies the fact that the closer λ_2 is to zero, the more integrated some particular market is. Final step in the second robustness check is the following cross-sectional regression:

$$\widehat{\boldsymbol{Seasonality}_c} = \alpha_c + \beta\, \widehat{IntegrationRobustness}_c + \varepsilon_c \quad (20)$$

where we have previously obtained one R^2 value for each country and thus generated country specific seasonality measure $\widehat{\boldsymbol{Seasonality}}_{\boldsymbol{c}}$.

We chose to employ time-varying coefficients from equation (6) instead of static as in equation (4), because here lambda is a risk premium, which can only be reliably estimated if one has multiple time periods in the regressions. Indeed, when the market returns are low or negative, high beta stocks do worse than low beta stocks, obscuring the premium, thus we need time variation in the variables in order to get more reliable and valid results.

5. Analysis of Results

5.1. Seasonality in the stock market liquidity

We begin our analysis by looking at the presence of seasonal variation in liquidity provision. We used relative bid-ask spreads and volume turnovers as proxies for liquidity for our sample of 36 financial markets. It has to be noted, that higher values of relative spreads (larger trading costs) suggest lower level of liquidity, while higher values of turnover (enhanced trading activity) imply higher level of liquidity. Moreover, at some certain steps of our analysis, for the sake of being able to draw different comparisons, we divided the whole sample into several subgroups according to geographic regions, size of the market based on FTSE (2015) Global Equity Index Series or degree of financial development. All the presented results for the coefficients were significant at 1% significance level, unless otherwise indicated.

Our monthly dummy variables implied that during winter the difference between quoted bid and ask price tended to be smaller in all markets. On average the highest increase in liquidity provision occurred in January and February, when the relative spreads were lower by 3.83% and 3.5% respectively with regard to our baseline value - December. The reverse trend (decrease in liquidity provision) started in March and reached its peak in June, when relative bid-ask spreads were 5.59% higher in comparison to December. In 75% of the countries with significant summer dummies we documented an increase in bid-ask spreads during summer, which implies that liquidity dries up during this period. Judging by our results, both developed and developing countries exhibited similar decline in the summer period (Tables G.2 and G.3). If we look at different parts of the world, then the highest dip in the relative bid-ask spreads occurred in Africa and Asia, whose liquidity, proxied by the abovementioned measure, dropped by 9% and 8.48% in June respectively. Europe and North America experienced similar decline in liquidity of 5.27% and 5.54%, while Oceania and South America showed slightly less significant results with smaller magnitude during the summer months.

After studying the relative spreads, we turned our attention to turnovers. All regions except for Africa and South America exhibited a drop in turnovers during summer period. Europe and Asia had the most significant decrease in stock turnovers by 10.2% and 6.45% respectively, which was consistent with the findings of Hong and Yu (2009), who reported a drop in turnovers by 15.8% and 3.2% respectively. Having calculated the results for the ten largest markets and the rest (Tables G.4 and G.5), we inferred that, in general, larger financial markets experience higher drop in turnovers during summer. The same was true for

developed and developing countries, where the former had a decrease of 8.2% in turnovers in June, while the latter showed a decline of only 1.86%.

5.2. Influence of earnings announcements on seasonality in the stock market liquidity

Having conducted initial regressions with monthly dummies, we turned to earnings announcements. We used both relative spreads and turnovers as our liquidity measures and built earnings season dummies for the first two weeks after the fiscal quarter end and for the subsequent two weeks.

Altogether, 23 out of 36 countries had significant earnings season dummies. This indicates that the presence of financial reporting period induces seasonality in liquidity provision by traders. When ES_{ct} dummies for both earnings periods were included in one regression, the results for all markets showed that, on average, only one dummy accounting for the second period was significant (Table G.1). After adding ES_{ct} dummies, the coefficients of the months retained their significance and magnitude.

On average, earnings dummies led to widening of relative bid-ask spreads by 1.64% during the first two weeks after the reporting period and narrowing during the subsequent two weeks by -2%. The magnitude of this change differed for developed and emerging markets (Tables G.2 and G.3). The former had a drop of 1.05% and a rise of 1.71% in liquidity, while the latter had almost double the size of change in coefficients, namely, 3.6% and -3.81%. Furthermore, once we took the ten largest markets and the rest, the former group of countries had a pronounced drop in liquidity equal to 4.26% during the first two weeks of the earnings season and a positive bounce back in liquidity equal to 4.46% during the consequent two weeks. The effect of the ES_{ct} dummies on liquidity in the remaining markets was less than 1% (Tables G.4 and G.5).

As for the geographical regions, the majority of them displayed an initial rise in liquidity provision and a subsequent decline (Tables G.6-11). However, this pattern did not hold in North and South Americas (Table G.9 and G.10), as well as in such countries as China, the UK and Italy, which first exhibited a drop in their spreads and then an increase during the next period.

We also carefully studied the effect of post-earnings announcements period, when our liquidity measure was proxied by turnovers. In the first two weeks after the news release date, turnovers of 36 countries in our sample declined by 3.23%, while they rose by 3.59% in the subsequent two weeks. It must be noted, that countries with significant ES_{ct} dummies in the first period did not necessarily retain this significance during the second, for instance,

Switzerland, Belgium and South Africa, reported significant ES_{ct} dummies in both periods, while other markets such as India and the Philippines displayed significant earnings season dummy only during the last two weeks of the month. Another point worth noting is that the signs for relative spreads coefficients were opposite to the ones of turnovers, which could be attributed to the negative correlation of -0.3547 between these two measures.

Similarly to the situation with relative bid-ask spreads, emerging markets experienced a much more profound influence of the earnings season's period than developed ones (Tables G.3 and G.2). However, the effect of ES_{ct} coefficients was the strongest for the ten largest financial markets (Table G.4). During the first two weeks of the earnings period, turnovers dropped by 4.48% in the top ten economies, while they declined by only 1.94% in the remaining countries. During the next period, changes in the liquidity were 6.1% and 1.97% respectively for the abovementioned samples.

Our results illustrate that earnings seasons affected the provision of seasonality in liquidity, when we used both turnovers and relative bid-ask spreads.

5.3. Influence of financial integration on seasonality in the stock market liquidity

We analysed the influence of the degree of a country's financial integration on the seasonality in the stock market liquidity via constructing our seasonality measure $\widehat{Seasonality}_{it}$ from time-varying R^2 values in regression (10). On average, the change in the level of market liquidity explained by monthly dummies, was around 20% (see Appendix B, Table B.3). We showed that 1% increase in the level of a particular country's degree of financial integration led to a less than 1% change in the level of seasonality. This finding implies that, although integration had statistically significant effect on seasonality at 1% or 5% significance level (depending on the employed liquidity measure), still the economic influence was not big. It makes sense given that nowadays countries are highly interrelated and financial markets are very developed, thus one should not observe very high discrepancies in seasonality depending on the level of integration. Furthermore, in order to make the description of specific results clearer, we present the outcome depending on whether the employed liquidity measure was (a) relative spreads or (b) turnovers.

In case (a) we obtained results which are depicted in Appendix B (Table B.1 and B.3). Integration had positive effect on seasonality with the coefficient equal to 0.0037 ($p<0.001$), meaning that a country which was more integrated into the global market should experience higher level of seasonality. This outcome remained statistically significant at 5% significance level even after accounting for possibility of heteroscedasticity and lack of normality.

For the case (b) regression output is presented in Appendix B (Table B.2 and B.3). The value of integration coefficient, when the seasonality measure was built from turnovers, was negative (-0.005). This result gave opposite conclusions in comparison to the ones for relative spreads. Indeed, here integration was negatively related to seasonality, meaning that more integrated financial markets should experience less pronounced seasonality in the stock market liquidity.

Moreover, further we expanded the basic integration model with earnings variables. Earnings measures which were based on relative spreads and the first two weeks after the fiscal quarter end enhanced the level of seasonality in the stock market liquidity, while variables built from turnovers for the same earnings season period decreased it (see Appendix B, Table B.3). This is consistent with the findings for the first hypothesis, which showed that once there was an increase in trading costs measured by relative spreads, trading activity dropped. The negative correlation between the chosen liquidity measures to a large extent drove the differences in the reported results.

In general, the results indicate that the level of particular market's financial integration had a significant influence on that market's seasonality in liquidity.

5.4. Influence of macroeconomic news announcements on seasonality in the stock market liquidity

Previously we defined dummy variables for several important macroeconomics news announcements, namely the CPI and PPI indices, as well as GDP and employment rate. To reject or fail to reject our raised hypothesis, we collected the announcement dates for twelve large and important financial markets worldwide: Australia, Canada, Finland, Germany, Hong Kong, Italy, Japan, New Zealand, Sweden, Switzerland, the United Kingdom and the USA. The choice of the abovementioned countries was driven by data availability. Having selected the financial markets, we tested our hypothesis by regressing the liquidity measures (both relative spreads and turnovers) on macroeconomic news announcements and then also added the earnings news announcements to the regression.

Our results for the panel of all sample countries implied that all four types of news announcements had a significant explanatory power (at 1% significance level) for both relative bid-ask spreads and turnovers (Table F.3). Once we looked at the effect of GDP news announcements, relative spreads dropped by 3.69% and turnovers volume grew by 2.23%, while employment disclosures slightly affected liquidity measures causing relative bid-ask spreads to increase by 2.01% and turnovers by 0.47%. PPI and CPI index announcements displayed similar effect to the one that GDP had on both relative bid-ask spreads and

turnovers, namely, on the announcement dates of PPI and CPI disclosures relative bid-ask spreads narrowed by 0.643% and 0.733%, while turnovers increased by 0.7% and 0.134%.

Having looked closer at each market, we noticed that every country had its idiosyncratic channel of influence on liquidity, ranging from all four macroeconomic news announcement measures being significant in Italy and the USA, and only one of them being significant in Canada, Finland and the UK.

We continue our analysis by looking more thoroughly at the impact of macroeconomic news announcements measures on turnovers and relative spreads in particular markets. CPI disclosures were significant in seven markets, while PPI announcements were statistically significant in only four countries. All measures, apart from PPI index disclosures, had either positive or negative effect on liquidity proxied by relative spreads depending on the country. PPI announcements had only a detrimental effect on relative spreads, which caused an increase in liquidity on the day of this announcement.

In general, CPI index announcements positively affected the provision of liquidity in New Zealand, Sweden and Hong Kong, where relative spreads on average decreased by 4.1%, 2.88% and 3.34% respectively on the day of the announcements. On the other hand, in Italy, Japan, Germany and the USA relative bid-ask spreads widen by approximately 7%, while the rest of the markets did not produce significant results for CPI news dummies.

The relative spreads of Japanese, UK and Australian companies showed a rise in liquidity on the day of GDP growth announcements, while Finland, Italy and the USA exhibited an opposite result. Australia had the highest decrease of 2.56% in relative bid-ask spreads on the GDP announcement date and Italy experienced the deepest dip in liquidity of 6.64%.

If we look at the significant coefficients for the effect of PPI announcements on each country's liquidity level, we see that relative spreads tended to widen. The most significant drop in liquidity occurred in Italy, where it declined by 9.86%. Canada and the USA had a similar dip in liquidity of 3.59% and 3.14% respectively.

Employment disclosures had a twofold effect on liquidity provision. On the one hand, such countries as the USA, Hong Kong and the UK experienced a decline in relative spreads on the news date. While other countries like, e.g., Japan and New Zealand illustrated the opposite outcome. The most notable increase in relative spreads took place in Italy, where it widened by 9.86%. Switzerland and Germany had a moderate increase in spreads of 5.51% and 6.06%, while Sweden, Canada and Finland showed a small rise in spreads of 1.19%, 1.14% and 0.46% respectively.

In our analysis, we also took a closer look on the effect of macroeconomic news announcements on turnovers. In general, all four news announcements were significant and had a positive impact on turnovers. For instance, CPI announcements had a very large effect on turnovers in Japan, where the trading activity decreased by 17% on the day of the news release. In Finland, Australia, the USA and Hong Kong the impact of CPI disclosures was less extreme, and at the same time CPI announcements were mostly significant at 5% level of significance in those markets. The next two measures having a sizeable effect on seasonality were employment announcements and PPI index disclosures. Both of them were significant at 1% significance level in five markets each. In the majority of cases, these macroeconomic news announcements had positive impact on turnovers, with the only outliers being Canada, the USA, New Zealand and Italy. Finally, GDP news announcements had a detrimental effect on liquidity by decreasing the value of stock turnovers on average by 0.5%. It must be noted that employment, PPI and CPI announcement dummies for relative bid-ask spreads were significant in Germany, while none of them retained this significance in case of turnovers, while Italy with all significant dummies managed to retain the significance of GDP and PPI announcements.

5.5. Robustness checks

5.5.1. Earnings and macroeconomic news announcements

The results of this robustness check are presented in Appendices I and J. On average the outcome of regressions with omitted January observations showed the same signs and similar level of significance as original results. Our earnings season dummies for all countries indicate that relative spreads increased by 0.735% during the first two weeks of post-earnings season period and turnovers declined by -1.03%, which is consistent with our baseline results, namely, change of 1.65% and -3.25% in the respective liquidity measures. The results for ES_{ct} dummy for the next two weeks of the earnings period showed an opposite trend. Indeed, relative bid-ask spreads dropped by 2.6% ($p<0.001$) during the second half of the post earnings period and turnovers increased by 5.24% during the same period, implying a boost in liquidity provision. For the purpose of comparison, we report our initial results for the same time frame of -2% and 3.6% respectively.

We also focus our attention on macroeconomic news announcements dummies, which retained their significance and signs of their coefficients even after we removed the month of January observations. We obtained similar outcome after analysing the results for individual markets (results not reported), as well as countries grouped by the degree of financial development and geographical regions.

In general, our main results for earnings seasons and macroeconomic news announcements are valid and remain statistical and economic significance after dropping the month of January observations.

5.5.2. Financial integration

Robustness checks for the second hypothesis also supported the findings of the main analysis via showing that integration had a statistically significant influence on the level of seasonality in the stock market liquidity. Both robustness tests implied the same pattern concerning the sign in front of the coefficient. Indeed, once we used relative spreads to build our seasonality measure, then integration was positively related to the level of seasonality with the coefficient equal to 0.003 ($p<0.001$) in the first robustness test and 0.69 ($p>0.10$) in the second. At the same time, when we used turnovers to build our seasonality measure and perform further analysis, then coefficients were negative (-0.0006 ($p<0.001$) and -0.7769 ($p< 0.10$) respectively). Joint F-statistics for the first robustness test were in the range 0.0000–0.1358 and for the second robustness check 0.0111–0.2585. The second robustness check had less statistical power, because it employed more aggregated measures (i.e., one value for each parameter for every country), which reduced the precision of the results.

Table 1. Summary of results

This table illustrates the summary of the obtained results for each hypothesis. "Yes" indicates a statistically significant result in the expected direction. "No" indicates a statistically significant result, which is opposite to what was expected. Outcome depends on the choice of the liquidity measure, which was either Relative Spread or Turnover.

Hypotheses		Relative Spread	Turnover
H1	Quarterly accounting earnings announcements are a significant driver of seasonality in the stock market liquidity.	Yes	Yes
H2	More integrated financial markets have less pronounced seasonality in liquidity due to smaller impact of idiosyncratic factors and more diversified investors' base.	No	Yes
H3	Stock market liquidity increases on the day of macroeconomic news announcements.	No	Yes

Source: Created by the authors.

6. Discussion of Results

6.1 Seasonality in the stock market liquidity

Having conducted the analysis, we confirm a few direct patterns applicable to all countries in our sample such as higher liquidity provision during winter and dip in turnovers during summer. These findings correspond to the ones obtained by Statman, Thorley and Vorkink (2006) and contradict the ones of Hameed et al. (2010). At the same time, we find a proof for higher trading costs in the form of larger bid-ask spreads during the summer period similarly to Hong and Yu (2009). Moreover, results from the full sample support the notion of the so-called Halloween effect or 'sell in May and go away' (Bouman & Jacobsen, 2002; Burton, 2010), where we see boosted trading costs starting from May till September, and for some groups of countries even till the late November (Appendix G). This finding suggests that May is the best time to leave the markets if one follows seasonal trading strategies. Indeed, for all regions in our sample trading is more costly during summer, which might be explained by "investors having gone on vacation" phenomenon described by Hong and Yu (2009). This assumption is further supported by the following observation: on average developed markets, which are mostly located in the Northern hemisphere where individuals possess seasonal vacation preferences, exhibit a higher drop in liquidity during summer than developing ones. Africa represents a peculiar case since the relative spreads of African companies widen, but at the same time turnover volume increases as well during summer. An increase in turnovers during this period could be explained by less pronounced variation in seasons due to the proximity of African countries to the Equator and rather homogeneous weather conditions throughout the year. However, it must also be noted that our sample containing African countries might be considered as biased due to the low number of financial markets included in it.

6.2 Earnings announcements

As a result of our analysis, we were able to test the first hypothesis and conclude that it cannot be rejected. Quarterly accounting earnings announcements, in fact, serve as a significant driver of seasonality in the stock market liquidity in a large number of markets. An important finding was obtained when we studied the results for regressions with earnings announcements dummies. In general, ES_{ct} dummies proved to be significant for relative spreads and negatively related to the turnovers, which can be explained in the following way. When a country experiences a decline in liquidity (proxied by relative spreads) due to ES_{ct} dummy, this variable should have a positive sign, while the same dummy will have a negative sign in the regression using turnovers as a proxy for liquidity. The reasoning for it is

as follows: as the level of liquidity becomes lower in a particular market, then the trading volume should decrease as well. Indeed, we find that correlation between the two chosen liquidity measures is negative (-0.3547), which supports the findings of Rubio and Tapia (1996), who also claim that spreads and volume based measures are negatively correlated.

Apart from the abovementioned finding, we also uncover differences in coefficients for two groups of countries. The first group comprises North and South Americas as well as France, the UK and Saudi Arabia that demonstrate decrease in relative bid-ask spreads during the first two weeks after earning release date and a subsequent increase in the consequent two weeks. The second group consisting from the remaining countries and regions in our sample exhibit an opposite trend, namely initial decline in liquidity provision and subsequent rise in it, which persists, when we divide financial markets by regions and level of financial development. The explanation offered by Nikiforov (2008) states that the so-called noise traders feel reluctant to trade before financial information is released due to the existence of informed traders, while market makers take care of the situation by widening bid-ask spreads and thereby affecting the liquidity provision in the markets. Even though this explanation could potentially explain the situation for the majority of countries and regions in our sample, it does not provide an answer for the results exhibited by North and South American countries obtained during the post-earning period. Another theory originated by Kim and Verrecchia (1994) allows us to provide an explanation to this occurrence. The authors claim that liquidity increases before and right after the earnings release date due to the elevated activity of informed traders, who are capable of interpreting the new information to gain profits. Thus, in our work we face the proofs for the existence of two competing theories. However, in order to be able to draw more reliable inference, one should conduct additional research studying the period right before and after the earnings announcements date.

6.3 Financial integration

At the first glance, the results for Hypothesis 2 might seem rather inconclusive and this hypothesis can be partly rejected, because, depending on which liquidity measure was used in order to build our seasonality measure, the conclusions about the effect of the level of the country's financial integration on the level of seasonality is opposite. However, these results can be explained.

The positive relationship between the seasonality and integration can be supported by, e.g., findings of Hong and Yu (2009). They document that bigger financial markets tend to have higher levels of seasonality in the stock market liquidity. Partly it can be explained by

the fact that majority of the advanced markets are located in the northern hemisphere, where people have seasonal preferences towards the time of their vacation. We argue that in many instances, the countries which can be described as the "biggest stock markets" also tend to be the most integrated into the global financial arena. This explains the results in Appendix B (Table B.1).

On the other hand, taking into account that more integrated markets should have less influence from the country specific parameters (e.g., distance from the Equator, cultural or religious factors) on their stock markets due to broad investor base, negative relationship between the seasonality and integration also makes a perfect sense (Appendix B, Table B.2). It is reasonable to assume that more integrated markets, where a large proportion of investors are foreigners, seasonality should be less pronounced, because the effect of individual trades of broad investors' base should cancel each other out.

We believe that the main explanation of opposite results lies in the choice of the particular liquidity measure. For example, relative spreads are more intuitively appealing measure of liquidity, because higher bid-ask spreads (lower liquidity) increase transaction costs and consequently diminish the demand for particular securities (Sarr & Lybek, 2002). This leads to a drop in the trading activity, and some previously active market participants might decide to exit the market. The increase in bid-ask spreads might trigger a vicious circle, where worsening of the one liquidity dimension negatively affects the others. Turnover, on the other hand, can be better described as a measure of the market activity. Consistent with Fong, Holden and Trzcinka (2014), the aforementioned explanations suggest that relative spreads and turnovers cannot be treated as perfect substitutes, and one should not expect these measures to produce the same results.

Indeed, our findings from both liquidity measures (i.e. relative spreads and turnover) show that, once we apply relative spreads, the outcome is stronger and has higher statistical power. Another explanation to different results is the fact that data, which is necessary for calculating turnover measure, was often missing or not announced by companies or the Datastream. Thus liquidity measure based on relative spreads can be seen as more reliable.

6.4 Macroeconomic news announcements

We can partly reject our third hypothesis stating that stock market liquidity increases on the day of macroeconomic news announcements. In fact, we document that different types of macroeconomic news announcements may have either positive or negative impact on the provision of liquidity proxied by relative spreads in the market. However, our panel

estimation suggests that on average macroeconomic news announcements have a positive effect on liquidity by increasing the share turnover. The major consequence of our analysis with regard to macroeconomic news relates to the country-specific nature of this type of determinant. At the same time, we find that CPI announcements affect the liquidity on a permanent basis in a significant number of markets, which is contradicting the findings of Chordia et al. (2003). In some markets such as Italy and the USA, investors might pay more attention to the macroeconomic news announcements by adjusting their trading volume, thereby, affecting the liquidity provision in the whole financial markets. In other countries, the impact of these determinants is less significant, e.g., in Canada and Sweden.

6.5 Limitations of the study

One of our main concerns is the ability to generalize obtained results if they depend on the choice of the particular liquidity measure. The problem might lie not only in the data availability issues, which are expressed in one of the previous subsections, but also in the fact that there are several dimensions of the market wide liquidity, and so far there has not been found one universal measure, which would capture all of them. It might be true that usage of a different liquidity measure, for example, Amihud, Zeros Impact measure or FHT Impact (Fong, Holden, & Trzcinka, 2014) would lead to different and maybe even opposite outcome. Thus the variability in obtained results might challenge the generalizability or external validity of the conclusions.

Apart from the issue mentioned above, we believe that more detailed analysis focusing on each specific determinant would be beneficial for understanding their impact on seasonality. For instance, given statements by, e.g., Lee et al. (1993) who argue that the major changes in liquidity occur in a few hour or day intervals around the news announcements, one is recommended to take high-frequency hourly data instead of low-frequency daily data, which would allow one to obtain more precise estimations. The need for using such granular data is dictated by the presence of the High Frequency traders and fast speed with which the new information is being incorporated into the equity prices, provided the markets are efficient.

Moreover, another limitation of our work is related to the choice of the specific macroeconomic news announcements. Apart from the disclosures used in our study (CPI, PPI, GDP and employment), we assume that not only macroeconomic news announcements, but also other types of public information such as speeches of the Chair of the Federal Reserve Board of Governors might affect the liquidity provision of traders.

Despite the outlined limitations of this study, we believe that, given our liquidity measures, our chosen explanatory variables are significant determinants of seasonality in the stock market liquidity, and our work has added new evidence to the existing literature in this field. Using excess number of various announcements in our thesis would have diluted the focus of the paper; thereby, we carefully approached the question of choosing the appropriate type of disclosures and determinants in general.

Finally, we can answer the posed research question and claim that the earnings and macroeconomic news announcements together with the degree of a market's financial integration are important determinants of seasonality in the stock market liquidity.

7. Conclusions

In this study we aim to find possible determinants that could cause seasonal changes in the level of the stock market liquidity. We apply panel data research design and propose three potential drivers of seasonality in the stock market liquidity, namely, earnings announcements, degree of market's financial integration and macroeconomic news announcements.

Our analysis of 36 financial markets around the globe during the period from 15th January 2010 till 15th January 2015 reveals that the suggested determinants significantly affect the provision of seasonality in liquidity proxied by relative bid-ask spreads and stock turnover on a regular basis. In our paper we synthesize the findings of previous researches and propose a few novel determinants. The greatest contribution of our study is that we find integration playing a role in affecting seasonality in liquidity. The effect of market's financial integration, earnings and macroeconomic news announcements on the aforementioned phenomenon is twofold, as these measures have significant positive or negative effect on seasonality in liquidity depending on the chosen financial market and liquidity proxy.

Our study fills in the gap in the existing knowledge, as present academic literature devotes scarce attention to the phenomenon of seasonality in the stock market liquidity. Besides, existing papers mostly concentrate on the US market, while our work examines much wider range of countries from all around the globe. In addition, we try to address the puzzle of contradictory evidence in the literature with respect to the provision of liquidity during summer months. Our results indicate that, generally, during summer period liquidity dries up, which is consistent with Bouman and Jacobsen (2002), while it opposes the conclusion of, e.g., Chordia et al. (2005) and Hameed et al. (2010). Furthermore, our work has practical implementation for those investors who follow seasonal trading strategies like, for example, 'sell in May and go away' by outlining specific seasonal trends in various countries.

Finally, we want to present a few suggestions for the future researchers. First, this paper concentrates on the month-of-the-year effect, but it might be worth coming up and testing possible determinants that could cause the so-called day-of-the-week effect in the stock market liquidity. Second, the authors of this paper mention that so far there is no one universal liquidity measure that captures all dimensions of the market liquidity and that results, which are obtained in this study, differ depending on the choice of the particular liquidity measure. Our suggestion would be considering and testing other types of liquidity proxies, e.g., the so-called Amihud or Zeros Impact measures, and seeing whether results

retain statistical and economic significance.

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Appendix A. Sample of stock markets

Table A.1

Note: This table illustrates the whole sample of countries that were used in this paper, respective stock exchanges and regions, where these states are located.

No.	Country	Stock Exchange	Region
1	Argentina	Buenos Aires Stock Exchange	South America
2*	Australia	Australian Stock Exchange	Oceania
3	Austria	Wiener Börse	Europe
4	Baltic countries	NASDAQ OMX Tallinn, Riga and Vilnius	Europe
5	Belgium	Euronext Brussels	Europe
6*	Brazil	BM&F Bovespa	South America
7*	Canada	Toronto Stock Exchange	North America
8	Chile	Santiago Stock Exchange	South America
9*	China	Shanghai Stock Exchange	Asia
10	Egypt	Cairo Stock Exchange	Africa
11	Finland	Helsinki Stock Exchange	Europe
12	France	Euronext Paris	Europe
13*	Germany	Frankfurt Stock Exchange	Europe
14	Hong Kong	Hong Kong Stock Exchange	Asia
15*	India	Bombay Stock Exchange	Asia
16	Indonesia	Jakarta Stock Exchange	Asia
17	Italy	Milan Stock Exchange	Europe
18*	Japan	Tokyo Stock Exchange	Asia
19	Malaysia	Bursa Malaysia	Asia
20	Mexico	Bolsa Mexicana de Valores	South America
21	Netherlands	Euronext Amsterdam	Europe
22	New Zealand	New Zealand Exchange	Oceania
23	Norway	Oslo Stock Exchange	Europe
24	Pakistan	Karachi Stock Exchange	Asia
25	Philippines	Philippines Stock Exchange	Asia
26	Poland	Warsaw Stock Exchange	Europe
27*	Russia	Moscow Exchange	Europe
28	Saudi Arabia	Tadawul (Saudi Stock Exchange)	Asia
29	Singapore	Singapore Exchange	Asia
30	South Africa	Johannesburg Stock Exchange	Africa
31	South Korea	Korea Exchange	Asia
32	Spain	Bolsa de Madrid	Europe
33	Sweden	Stockholm Stock Exchange	Europe
34	Switzerland	SIX Swiss Exchange	Europe
35*	United Kingdom	London Stock Exchange	Europe
36*	United States of America	New York Stock Exchange	North America

* Denotes top 10 largest financial markets according to FTSE Global Equity Index

Source: Created by the authors.

Appendix B. Regression results for the degree of financial integration influence on seasonality in the stock market liquidity

Table B.1

Note: This Table illustrates results for the stock level panel regressions, where the panel includes all sample countries. It is the final step for the Integration determinant testing, which is specified as:

$$\widehat{Seasonality}_{i\tau} = \alpha_i + \beta\, \widehat{Integration}_{i\tau} + e\, Earnings_{i\tau} + \varepsilon_{i\tau}$$

Here $\widehat{Seasonality}_{i\tau}$ is constructed by taking $Relative\ Spread_{it}$ as our liquidity measure. The authors of this paper have performed both simple OLS regressions and country fixed effects regressions, in order to account for the probability that some particular country characteristics might influence the results.

	OLS regressions					***Fixed effects regressions***				
Integration	*0.003733*** (11.10)*	*0.003753*** (11.18)*	*0.003752*** (11.18)*	*0.002982*** (8.87)*	*0.002982*** (8.87)*	*0.002723*** (8.18)*	*0.002723*** (8.18)*	*0.002730*** (8.20)*	*0.002244*** (6.74)*	*0.002246*** (6.75)*
Earnings_1		*0.105336*** (24.59)*	*0.090683*** (7.52)*	*0.092068*** (7.60)*	*0.092091*** (7.60)*		*-0.000308 (-0.05)*	*0.037133*** (3.19)*	*0.037230*** (3.18)*	*0.037261*** (3.18)*
Earnings_2			*0.016085 (1.30)*	*0.015684 (1.26)*	*0.015661 (1.26)*			*-0.044838*** (-3.70)*	*-0.043202*** (-3.55)*	*-0.043231*** (-3.55)*
Earnings_3				*-0.000002*** (-9.92)*	*-0.000002*** (-8.00)*				*-0.000002*** (-8.79)*	*-0.000002*** (-6.89)*
Earnings_4					*-0.000000 (-0.78)*					*-0.000000 (-1.07)*
constant	*0.219405*	*0.218085*	*0.218082*	*0.217443*	*0.217444*	*0.218854*	*0.218858*	*0.218910*	*0.218503*	*0.218503*
R^2	*0.08%*	*0.45%*	*0.45%*	*0.51%*	*0.52%*	*9.28%*	*9.28%*	*9.29%*	*9.37%*	*9.37%*
N	*161,780*	*161,780*	*161,780*	*153,383*	*153,383*	*161,780*	*161,780*	*161,780*	*153,383*	*153,383*

*** p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics. F-statistics is in the range from 0.0000 – 0.0001.

Source: Created by the authors using STATA regressions output.

Table B.2

Note: This Table illustrates results for the stock level panel regressions, where the panel includes all sample countries. It is the final step for the Integration determinant testing, which is specified as:

$$\widehat{Seasonality}_{it} = \alpha_i + \beta\, \widehat{Integration}_{it} + e\, Earnings_{it} + \varepsilon_{it}$$

Here $\widehat{Seasonality}_{it}$ is constructed by taking $Turnover_{it}$ as our liquidity measure. The authors of this paper have performed both simple OLS regressions and country fixed effects regressions, in order to account for the probability that some particular country characteristics might influence the results.

	OLS regressions					***Fixed effects regressions***				
Integration	*0.00001* *(1.44)*	*-0.005526**** *(-20.34)*	*-0.005521**** *(-20.32)*	*-0.005528**** *(-20.36)*	*-0.005528**** *(-20.36)*	*0.000010* *(1.58)*	*-0.002014**** *(-7.56)*	*-0.001999**** *(-7.50)*	*-0.002007**** *(-7.54)*	*-0.002008**** *(-7.54)*
Earnings_1		*0.017533**** *(5.09)*	*0.072360**** *(7.28)*	*0.072247**** *(7.27)*	*0.072161**** *(7.27)*		*0.006364* *(1.37)*	*0.076739**** *(8.07)*	*0.076585**** *(8.05)*	*0.07651**** *(8.05)*
Earnings_2			*-0.059941**** *(-5.88)*	*-0.059781**** *(-5.87)*	*-0.059692**** *(-5.86)*			*-0.083708**** *(-8.48)*	*-0.083565**** *(-8.47)*	*-0.083495**** *(-8.46)*
Earnings_3				*-0.000002**** *(-13.89)*	*-0.000003**** *(-13.43)*				*-0.000002**** *(-12.09)*	*-0.000002**** *(-11.65)*
Earnings_4					*0.000001**** *(3.63)*					*0.000001*** *(3.09)*
constant	*0.200385*	*0.194747*	*0.194757*	*0.19471*	*0.194706*	*0.200385*	*0.196802*	*0.19691*	*0.196867*	*0.196864*
R^2	*0.00%*	*0.28%*	*0.31%*	*0.43%*	*0.44%*	*10.56%*	*10.89%*	*10.93%*	*11.02%*	*11.02%*
N	*160,175*	*153,949*	*153,949*	*153,949*	*153,949*	*160,175*	*153,949*	*153,949*	*153,949*	*153,949*

***

p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics. F-statistics is in the range 0.0000 – 0.1137.

Source: Created by the authors using STATA regressions output.

Table B.3

Note: This Table illustrates results for stock level panel regressions with robust standard errors. Here we perform the same kind of regressions as in the Table B.1 and B.2. (specifically, country fixed effects regressions); however, in this regression output we have accounted for possible heterogeneity, lack of normality and correlation among individual error terms by employing robust standard errors.
In addition, the results are for two instances, when the $\widehat{Seasonality}_t$ measure is obtained either using liquidity measure based on relative spreads or turnovers.

	Relative Spread					***Turnover***				
Integration	*0.002723*** (3.07)	*0.002723*** (3.07)	*0.002730*** (3.08)	*0.002244*** (2.88)	*0.002245*** (2.88)	*0.000010* (1.07)	*-0.002014**** (-3.87)	*-0.001999**** (-3.85)	*-0.002007**** (-3.85)	*-0.002008**** (-3.85)
Earnings_1		*-0.000308* (-0.03)	*0.037133*** (2.11)	*0.037230*** (2.14)	*0.037261*** (2.15)		*0.006364* (0.95)	*0.076739**** (4.39)	*0.076585**** (4.38)	*0.076510**** (4.38)
Earnings_2			*-0.044838*** (-2.43)	*-0.043202*** (-2.36)	*-0.043231*** (-2.36)			*-0.083708**** (-4.86)	*-0.083565**** (-4.85)	*-0.083495**** (-4.84)
Earnings_3				*-0.000002**** (-4.21)	*-0.000002**** (-4.48)				*-0.000002**** (-6.12)	*-0.000002**** (-6.88)
Earnings_4					*-0.000000* (-0.39)					*0.000001* (1.31)
constant	*0.218854*	*0.218858*	*0.218910*	*0.218503*	*0.218503*	*0.200385*	*0.196802*	*0.196907*	*0.196867*	*0.196864*
R^2	*9.28%*	*9.28%*	*9.29%*	*9.37%*	*9.37%*	*10.56%*	*10.89%*	*10.93%*	*11.02%*	*11.02%*
N	*161,780*	*161,780*	*161,780*	*153,383*	*153,383*	*160,175*	*153,949*	*153,949*	*153,949*	*153,949*

*** p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics from robust standard errors. F-statistics is in the range from 0.0000 – 0.0089 for Relative Spread and 0.0000 – 0.2864 for Turnover.

Source: Created by the authors using STATA regressions output.

Appendix C. First robustness check for the integration determinant

Table C.1

Note: This Table illustrates results for the cross-sectional (country) regressions. It is the final step for the Integration determinant testing, which can be specified as:

$$\widehat{Seasonality}_i = \alpha_i + \beta\, \widehat{Integration}_i + e\, Earnings + \varepsilon_i$$

Here $\widehat{Seasonality}_i$ is constructed by taking $Relative\ Spread_{it}$ as our liquidity measure. The authors of this paper have performed both simple OLS regressions and country fixed effects regressions, in order to account for the probability that some particular country characteristics might influence the results.

	OLS regressions					***Fixed effects regressions***				
Integration	*0.0003399*** (8.51)*	*0.0003344*** (8.41)*	*0.0003351*** (8.45)*	*0.0003319*** (8.34)*	*0.0003319*** (8.34)*	*0.0003292*** (8.65)*	*0.0003244*** (8.56)*	*0.0003251*** (8.60)*	*0.0003236*** (8.53)*	*0.0003236*** (8.53)*
Earnings_1		*-0.086684 (-1.56)*	*-0.66049*** (-4.51)*	*-0.18019 (-1.08)*	*-0.179057 (-1.07)*		*-0.076505 (-1.44)*	*-0.59705*** (-4.24)*	*-0.122954 (-0.76)*	*-0.128081 (-0.79)*
Earnings_2			*-0.65526*** (-4.23)*	*-0.16275 (-0.93)*	*-0.162961 (-0.93)*			*-0.5956*** (-3.99)*	*-0.108989 (-0.64)*	*-0.111367 (-0.66)*
Earnings_3				*0.0000008 (1.09)*	*0.000001 (-0.11)*				*0.0000003 (0.46)*	*0.000005 (0.57)*
Earnings_4					*0.0000008 (-0.21)*					*0.000002 (0.53)*
constant	*0.0576648*	*0.057459*	*0.057326*	*0.057533*	*0.057531*	*0.057661*	*0.057450*	*0.057329*	*0.05755*	*0.057563*
R^2	*2.09%*	*2.12%*	*2.64%*	*2.15%*	*2.15%*	*12.03%*	*12.17%*	*12.44%*	*12.02%*	*12.08%*
N	*3,387*	*3,381*	*3,381*	*3,284*	*3,281*	*3,387*	*3,381*	*3,381*	*3,284*	*3,281*

*** p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics. F-statistics is 0.0000.

Source: Created by the authors using STATA regressions output.

Table C.2

Note: This Table illustrates results for the cross-sectional (country) regressions. It is the final step for the Integration determinant testing, which can be specified as:

$$\widehat{Seasonality}_i = \alpha_i + \beta\, \widehat{Integration}_i + e\, Earnings_i + \varepsilon_i$$

Here $\widehat{Seasonality}_i$ measure is constructed by taking $Turnover_{it}$ as our liquidity measure. The authors of this paper have performed both simple OLS regressions and country fixed effects regressions, in order to account for the probability that some particular country characteristics might influence our results.

	OLS regressions					***Fixed effects regressions***				
Integration	*-0.0000609** *(-1.65)*	*-0.0000602* *(-1.64)*	*-0.0000601* *(-1.64)*	*-0.00006** *(-1.66)*	*-0.00006** *(-1.66)*	*-0.0000625** *(-1.72)*	*-0.0000617** *(-1.71)*	*-0.0000617** *(-1.71)*	*-0.0000616** *(-1.74)*	*-0.0000616** *(-1.74)*
Earnings_1		*0.09424** *(1.82)*	*0.03983* *(0.797)*	*0.038446* *(0.25)*	*0.042658* *(0.28)*		*0.1065347** *(2.09)*	*0.0875392* *(0.57)*	*0.0880808* *(0.58)*	*0.0919767* *(0.61)*
Earnings_2			*-0.06061* *(-0.37)*	*-0.06459* *(-0.40)*	*-0.064418* *(-0.40)*			*-0.0211997* *(-0.13)*	*-0.022915* *(-0.14)*	*-0.0222879* *(-0.14)*
Earnings_3				*0.000001* *(-0.79)*	*0.000006* *(-0.74)*				*0.0000006* *(-0.94)*	*0.000005* *(-0.66)*
Earnings_4					*0.000002* *(-0.68)*					*-0.000002* *(-0.58)*
constant	*0.057709*	*0.057491*	*0.0574827*	*0.0570966*	*0.0570792*	*0.0577087*	*0.0574827*	*0.0574797*	*0.057097*	*0.0570823*
R^2	*0.1%*	*0.18%*	*0.19%*	*0.22%*	*0.23%*	*5.06%*	*5.06%*	*5.06%*	*5.09%*	*5.10%*
N	*3,281*	*3,266*	*3,266*	*3,223*	*3,223*	*3,281*	*3,266*	*3,266*	*3,223*	*3,223*

*** p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics. F-statistics is in the range from 0.0000 – 0.1358.

Source: Created by the authors using STATA regressions output.

Table C.3

Note: This Table illustrates results for cross-sectional (country) regressions with robust standard errors. Here we perform the same kind of regressions as in the Table C.1 and C.2. (specifically, country fixed effects regressions); however, in this regression output we have accounted for possible correlation among individual error terms and used clustered robust standard errors.
In addition, the results are for two instances, when the $\widehat{Seasonality}_t$ measure is obtained either using liquidity measure based on relative spreads or turnovers.

	Relative Spread					***Turnover***				
Integration	*0.000329*** (36.55)*	*0.000324*** (114.71)*	*0.000325*** (113.63)*	*-0.000324*** (119.36)*	*0.000323*** (118.55)*	*-0.000063*** (-61.10)*	*-0.000062*** (-72.84)*	*-0.000062*** (-72.00)*	*-0.000062*** (-69.09)*	*-0.000062*** (-69.21)*
Earnings_1		*-0.076505 (-0.97)*	*-0.597059*** (-3.03)*	*-0.122954 (-0.34)*	*-0.128091 (-0.36)*		*0.1065347** (2.38)*	*0.0875392 (0.50)*	*0.0880808 (0.50)*	*0.0919767 (0.60)*
Earnings_2			*-0.595601*** (-3.15)*	*-0.108989 (-0.27)*	*-0.111367 (-0.28)*			*-0.0211997 (-0.11)*	*-0.022915 (-0.11)*	*-0.0222879 (-0.11)*
Earnings_3				*0.0000003*** (4.48)*	*0.000005*** (3.99)*				*0.000005*** (-13.75)*	*0.000005*** (-6.30)*
Earnings_4					*0.000002*** (3.87)*					*-0.000002*** (-5.79)*
constant	*0.0576607*	*0.0574501*	*0.0573288*	*0.0575454*	*0.0575629*	*0.0577087*	*0.0574827*	*0.0574797*	*0.057097*	*0.0570823*
R^2	*12.03%*	*12.17%*	*12.44%*	*12.02%*	*12.08%*	*5.06%*	*5.06%*	*5.06%*	*5.09%*	*5.10%*
N	*3,287*	*3,281*	*3,381*	*3,284*	*3,281*	*3,281*	*3,266*	*3,266*	*3,223*	*3,223*

*** p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics from robust standard errors. F-statistics is 0.0000 for both Relative Spread and Turnover.

Source: Created by the authors using STATA regressions output.

Appendix D. Second robustness check for the integration determinant

Table D.1

Note: This Table illustrates the results for the second robustness check of the integration determinant.

The model is specified as:

$$\widehat{Seasonality}_c = \alpha_c + \beta\, \widehat{IntegrationRobustness}_c + \varepsilon_c$$

Here are represented two instances, when $\widehat{Seasonality}_c$ measure is built either from relative spreads or turnovers. The authors of this paper also apply robust standard errors to account for the possible heterogeneity and lack of normality.

	Relative Spreads	***Turnovers***	***Relative Spreads***	***Turnovers***
			Robust standard errors	
Integration Robustness	*0.693548* *(1.15)*	*-0.776930** *(-1.85)*	*0.693548* *(1.57)*	*-0.776930*** *(-2.69)*
constant	*0.059216*	*0.057403*	*0.059216*	*0.057403*
R^2	*3.74%*	*9.12%*	*3.74%*	*9.12%*
N	*36*	*36*	*36*	*36*

*** p<0.01, ** p<0.05, * p<0.1

Parentheses illustrate t-statistics from robust standard errors. F-statistics is in the range from 0.0111 – 0.2585.

Source: Created by the authors using STATA regressions output.

Appendix E. Correlation between Relative Spread and Turnover

Table E.1

Note: This Table shows the correlation coefficient between the two liquidity measures (Relative Spread and Turnover) employed in this paper. These results are obtained once using the panel of all sample countries.

	Relative Spread	***Turnover***
Relative Spread	*1.0000*	
Turnover	*-0.3547*	*1.0000*

Source: Created by the authors using STATA output.

Appendix F. Macroeconomic news announcements

Included in the original paper. Available upon request.

Appendix G. Earnings news announcements

Included in the original paper. Available upon request.

Appendix I. Robustness check for earnings announcements determinant

Included in the original paper. Available upon request.

Appendix J. Robustness check for macroeconomic news announcements determinant

Included in the original paper. Available upon request.