Stock market activity and Google Trends: the case of a developing economy

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Abstract

Purpose – The purpose of this paper is to investigate the impacts of investor attention on stock market activity.
Design/methodology/approach – The authors employed the Google Search Volume (GSV) Index, a direct and non-traditional proxy for investor attention.
Findings – The results indicate a strong correlation between GSV and trading volume – a traditional measure of attention – proving the new measure's reliability. In addition, market-wide attention increases both stock illiquidity and volatility, whereas company-level attention shows mixed results, driving illiquidity and volatility in both directions.
Originality/value – To the best of the authors' knowledge, Nguyen and Pham's (2018) study has been the only previous study identifying investor attention in Vietnam by using GSV as a proxy and examining the impacts of broad search terms about the macroeconomy on the stock market as a whole – on stock indices' movements. The paper will contribute to this by quantifying GSV impacts on each stock individually.

Keywords Google Trends, Search engine, Investor attention, Stock illiquidity, Stock volatility

Paper type Research paper

1. Introduction

Classical economic models assume immediate incorporation of new information into asset price, which implies instantaneous mental processing of any information load (Da *et al.*, 2011). But in reality human attention capacity is limited, and paying attention to information exhausts this capacity (Kahneman, 1973). Meanwhile, the relevant information load presented in everyday life easily outweighs the maximum load that a human being can react to (Sims, 2003). This abundance of information uses up attention and hence creates a "poverty of attention" (Simon, 1971). This argument of limited attention resource can be applied to the stock market. It is difficult for individual investors to come up with an optimal choice by analyzing hundreds of stocks in full detail, therefore they have to reduce pool of options to stocks that attract them the most (Barber and Odean, 2007). As a result, for one specific stock, the pool of investors knowing about it is limited despite abundance of information (Merton, 1987). Arrival of price-changing information, therefore, may see under-reaction, delaying trading activities and price correction (Dellavigna and Pollet, 2009; Aouadi *et al.*, 2013). On the other hand, for different stocks, ones that attract more attention tend to see increased individual investor net buying (Seasholes and Wu, 2007; Barber and Odean, 2007), increased

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trading volume and liquidity (Grullon *et al.*, 2004; Aouadi *et al.*, 2013) and a hike-and-reverse period of returns (Seasholes and Wu, 2007; Chemmanur and Yan, 2019).

Attention is a difficult factor to measure directly. The traditional indirect proxies can be divided into two groups. The first group includes potential causes of abnormal attention: advertising expense (Chemmanur and Yan, 2019; Grullon *et al.*, 2004), media and news coverage (Barber and Odean, 2007; Fang and Peress, 2009) and day of week (Dellavigna and Pollet, 2009). The second group, potential effects of abnormal attention, is mostly extracted from trading statistics. These include trading volume (Barber and Odean, 2007; Chemmanur and Yan, 2019), extreme stock returns (Barber and Odean, 2007) and stock prices (Seasholes and Wu, 2007). The need for a more direct proxy for attention emerges. The internet and online search engines today have become the cheapest and simplest way to obtain public information. Google Search has long been the dominant search engine all over the world, with 93 percent of world market share in March 2019[1]. Data on Google search engine's keyword popularity is available to the public via another service by Google – "Google Trends." Google search volume (GSV) tracked by Google Trends emerged as a predictor among various research topics, ranging from influenza (Ginsberg *et al.*, 2009) to vehicle sales and real estate prices among regions (Choi and Varian, 2012). Reliable predictions can be made up to a month earlier than official reports. In addition, ambiguity is significantly reduced, as attention is the only explanation for a person searching the internet for a keyword. These make Google search value a much more direct and timely proxy of attention. GSV has also appeared in the specific topic of stock market activity. This proxy is tested for effects on liquidity and stock returns, similar to tests conducted on other attention measures. The majority of studies show similar, but timelier results than traditional attention studies (Ding and Hou, 2015; Aouadi *et al.*, 2013; Da *et al.*, 2011).

Internet penetration in Vietnam tripled within ten years reaching to 47 percent in 2016[2]. Out of the total number of investors in Vietnam, 99.5 percent are individual investors[3], who have less access to complicated information sources than institutional investors, and who depend on cheap and quick sources such as the internet. With these characteristics, Vietnam stock market provides an ideal context to apply online search volume as a proxy for attention, and test for its effects.

In this paper, we examine impacts of stock-specific and market-related attention, measured by GSV, on stock illiquidity and stock volatility. We first find strong correlation between GSV and trading volume, a popular traditional proxy for investor attention. Then for attention impacts, whereas market-related GSV Index reduces individual stock liquidity, volume of firm-level search queries shows mixed results. In addition, market-wide attention increases stock volatility, whereas firm-level attention, again, can either reduce or increase volatility in stock returns. We examine 49 stock tickers included in VN-100 Index of Ho Chi Minh Stock Exchange (HOSE) as of January 1, 2019. The studied time span is five years, ranging from January 2014 to December 2018 – the latest and largest time span with weekly Google Trends data available.

This paper links directly to the study by Aouadi *et al.* (2013) across 27 stocks from CAC40 (France). The study finds consistent positive impact of stock-specific GSV on liquidity, whereas market-related GSV shows the opposite. Regarding stock volatility, stock-specific attention either reduces or increases volatility, whereas market-wide attention exhibits consistent positive effects. Our paper contributes to the literature with evidence from a developing economy, which is different from developed markets like France. Specifically, our results suggest a trait of a developing economy where there is a large population of individual investors and less market transparency: trading behaviors tend to be more trend following and less fact grounded than in developed markets. This is reflected in our finding that stock-specific attention drives illiquidity toward both directions.

As far as we are concerned, Nguyen and Pham's (2018) study is the only previous study on investor attention in Vietnam that uses GSV as a proxy. They examine impacts of broad search terms about the macroeconomy on the stock market as a whole – on stock indices' movements. We contribute to this by quantifying GSV impacts on each stock individually.

The rest of this paper is organized as follows. Section 2 reviews literature on investor attention and GSV as an attention proxy, and then develops four hypotheses on this ground. Section 3 reports data and methodology. Section 4 tests the impact of investor attention on stock illiquidity and stock volatility. Section 5 concludes the paper.

2. Literature review and hypotheses development

Sims (2003) attributes inattentiveness to the fact that the economically relevant information load a person encounters every day easily exceeds the amount that they can make a proper response to. Simon (1971) concludes that an abundance of information uses up the limited attention resource, hence creates a "poverty of attention," and that there are optimal ways to distribute this resource on excessive information loads. These open up the possibility of an application to the stock market, where there are many different stocks to choose from, which exhaust investor attention. Merton's (1987) model follows up with this, implying that incomplete investor recognition exists among different stocks despite abundance of information, and this incomplete recognition has an impact on asset pricing. More specifically, price-changing information may be ignored by part of the market temporarily (Aouadi *et al.*, 2013). Trading activity, therefore, lags behind information arrival (Dellavigna and Pollet, 2009), delaying incorporation of information into prices.

Among different stocks, ones that attract more attention attract more buying from individual investors, rather than institutional investors (Seasholes and Wu, 2007; Barber and Odean, 2007). Barber and Odean (2007) argue that institutional investors struggle less with cognitive biases, as they devote more time, human resources and technologies to conduct better and more timely processing of information. Attention-grabbing stocks also see increased trading volume and liquidity (Grullon *et al.*, 2004; Aouadi *et al.*, 2013). This effect stems from reduced asymmetric information costs which make prices less sensitive to a dollar traded, therefore more pronounced among smaller firms which the market lack information about, or pay less attention to (Chemmanur and Yan, 2019; Bank *et al.*, 2011). Regarding volatility, attention-driven trading may either create an overreaction to information, therefore a stronger hike-and-reversal period of returns (Seasholes and Wu, 2007; Chemmanur and Yan, 2019), or reduce price fluctuations due to new information spreading quickly, reducing uncertainty (Fang and Peress, 2009).

Expanding on the attention subject, rather than simply attention vs inattention, there are more than one dimension to this field, in which two are attention to one object and attention to multiple objects, as suggested by Kahneman (1973). Accordingly, the former type takes more mental effort than the latter. Drawing an analogy, Barber and Odean (2007) argue that it is difficult for individual investors to analyze hundreds of stocks and come up with an optimal choice. Instead, they have to choose from, for example, ten options that attract them the most, before continuing with detailed analysis.

Aouadi *et al.* (2013) go further to test the effect of both types of attention on stock liquidity and volatility. Regarding liquidity, the study finds consistent positive impact of stock-specific attention, which is similarly explained by a reduction in asymmetric information costs. Meanwhile, the second type – market-related attention – shows the opposite impact. This is attributed to the larger uncertainty that investors face when presented with market-wide information, requiring more research efforts, decreasing liquidity (Seasholes and Wu, 2007; Aouadi *et al.*, 2013). Regarding stock volatility,

stock-specific attention, again, drive volatility toward both directions, which is also explained similarly to other studies. First, attention reduces uncertainty and, therefore, decreases volatility; second, new information manifests into the new prices, constantly correcting them, increasing volatility. On the other side, attention on market as a whole presents less specific information, therefore exhibits positive effect on volatility (Seasholes and Wu, 2007; Aouadi *et al.*, 2013). Attention is a difficult factor to measure directly. The traditional proxies include potential causes for abnormal attention, or potential effects of abnormal attention. Both of these groups are to some extent indirect. The former group includes advertising expense (Chemmanur and Yan, 2019; Grullon *et al.*, 2004), media and news coverage (Barber and Odean, 2007; Fang and Peress, 2009) and day of week (Dellavigna and Pollet, 2009). Each of these factors is neither necessarily the determinant, nor the only determinant of attention. Therefore, attention may be missed out from measurement. Moreover, in some cases, exogenous factors driving attention may take effect during the delays in time between the proxy and investors' actual obtainment of information. The latter group, most of which tries to extract trading behavior from trading statistics, is even more indirect. This includes trading volume (Barber and Odean, 2007; Chemmanur and Yan, 2019; Hou *et al.*, 2009), extreme stock returns (Barber and Odean, 2007) and stock prices (Seasholes and Wu, 2007). Not only are these measures delayed in time, they are also results of a combined effect from different economic factors unrelated to investor attention. Additionally, there is a two-way causal loop between these proxies and attention itself. Attention can induce higher trading volume, and trading volume, in turn, attracts more attention.

GSV data, provided by Google Trends, emerged as a tool to predict various researched factors, ranging from influenza (Ginsberg *et al.*, 2009) to vehicle sales and real estate prices among regions (Choi and Varian, 2012). Reliable predictions can be made up to a month earlier than official reports. The time gap between entering a search command on Google and actually obtaining information is minimal. Also, ambiguity is significantly reduced, as attention is the only explanation for a person searching the internet for a keyword. These make Google search value a timelier and more direct proxy of attention.

GSV has also emerged in the specific topic of stock market activity. GSV proves to be a reliable proxy of investor attention, not only by a strong correlation with traditional measures but also timelier results (Aouadi *et al.*, 2013; Da *et al.*, 2011). Similar to the case of traditional measures, empirical results show that this new measure is also a determinant of increased stock liquidity (Ding and Hou, 2015; Aouadi *et al.*, 2013), increased stock volatility (Kita and Wang, 2012) and stronger hikes followed by stronger reversals of returns (Da *et al.*, 2011; Bank *et al.*, 2011).

Attention is also studied in connection with stock market activity in emerging and frontier markets. Jiang *et al.* (2016) employed price limits – a feature of many regulated emerging markets – as a proxy for attention and found increased chance for anomalies occurring to stocks attracting abnormal attention. On the contrary, employing search frequency index itself, but from Baidu – a search engine working within the closed network of China – Ying *et al.* (2015) document a return hike followed by reversal of returns associated with attention in this emerging market.

2.1 Hypotheses development

Following Aouadi *et al.* (2013), we test the effects of investor attention on stock-specific and market-wide information separately, trying to differentiate between the two types of attention. We choose to study attention effects on two characteristics of each stock: liquidity and volatility. Whereas liquidity, as argued by Aouadi *et al.* (2013), reflect asymmetric information costs, volatility is a measure of risk and uncertainty – the absence of information itself. These would capture the impacts from the two different ways of

accessing information, or in other words, the two types of attention. Therefore, we aim to test the following four hypotheses on Vietnam stock market:

H1. Investor attention to a specific stock reduces its illiquidity, by reducing the asymmetric information costs.

H2. Investor attention to the whole market increases individual stock illiquidity, due to uncertainty among many options.

H3. Investor attention to specific stock reduces its volatility, by reducing uncertainty with information on specific options.

H4. Investor attention to the whole market increases individual stock volatility, due to uncertainty among many options.

3. Data and methodology

Google Trends allow users to select a time span, with the furthest date dating back to 2004, and data are updated daily. Users can also select frequency interval for observations, e.g. daily, weekly or monthly search volume. For larger time spans, less frequent data are available. To more exactly capture the speed of information incorporation into stock price, we collect weekly GSV observations for each stock, instead of daily or monthly. The reasoning is that the market's aggregate attention to a stock as a reaction to any information cannot be reflected in one day's search volume. Not all investors notice the new information immediately, and after attention has been paid, investors do not search for the stock just once. Similarly, monthly data do not differentiate attention levels accurately. As attention may die out during a few days, months with attention-grabbing events may not show significantly higher GSV than other months. Weekly data maintain balance between these, which allows for a lagged human reaction to new information on the market while still reflecting differences among observations more clearly. Weekly data for Google Trends are available for a maximum time span of five years.

We examine stock tickers included in VN-100 Index of HOSE as of January 1, 2019. HOSE is the largest stock exchange in Vietnam and most stocks are listed here. VN-100 Index includes the largest 100 stocks at HOSE in terms of charter capital. Together, VN-100 Index makes up more than 80 percent of market capitalization of Vietnam's stock market[4]. We exclude any ticker that has been listed for less than 150 working weeks up to January 2019 to avoid biased results. Google Trends automatically scales its search volume data for each keyword by its time series average, to a scale from 0 to 100. Therefore, it is not possible to compare search volumes of different keywords, and the absolute number of searches is not available. Instead, the information that can be inferred from the data is the popularity of each keyword compared to itself over time. This scaled data are hereafter referred to as Search Value Index (SVI).

Weekly SVI is collected in a time span of five years (2014–2018). We employ stock tickers as search terms, rather than company names, which may be searched for non-investing purposes. A search on "Vietcombank," for example, may be seeking information on this bank rather than the VCB stock itself. We exclude various stock tickers with different meanings as search queries such as AAA (a battery product name), SCR (motorcycle model), etc. See Table AIII for these excluded tickers. We are left with 49 stock tickers which are not mistaken by Google Trends for any search purposes other than the stock themselves, and which have been listed for at least 150 working weeks. For market-related attention, we choose the keyword "VN-Index," which is the name of the primary stock index in Vietnam, representing the whole market's performance.

Data on historical stock prices and volumes at HOSE are obtained from cafef.vn. Financial statements data for the period 2005–2017 are provided by Stoxplus. Data on the number of outstanding shares are provided by Stoxplus. Stock-specific SVI ($SVI_{i,w}$) and market-related SVI ($SVImarket_{i,w}$) data from Google Trends are transformed to the natural logarithmic scale (Table I).

The study conducts two regression models, after conducting a unit root test, which rejects the null hypothesis of unit root existing in the main variables of the time series. Following Aouadi *et al.* (2013), we construct the two models using variables as follows.

Model I:

$$TPI_{iw} = a_0 + a_1 \times \mathrm{Ln}(\mathrm{SVI}_{i,w-1}) + a_2 \times \mathrm{Ln}(\mathrm{SVImarket}_{i,w-1}) + a_3 \times \mathrm{Ln}(\mathrm{Marketcap}_{i,w-1}) + a_4 \times \mathrm{TPI}_{i,w-1} a_5 \times \mathrm{Ln}(\mathrm{Marketcap}_{i,w-1}) \times \mathrm{Ln}(\mathrm{SVI}_{i,w-1}) + a_6 \times \mathrm{Return}_{i,w-1} + a_7 \times \mathrm{Sd}(\mathrm{Return}_{i,w-1}) + a_8 \times \mathrm{Weekvol}_{i,w-1} + a_8 \times (w-1) + \varepsilon,$$

No.	Ticker	Company name	No.	Ticker	Company name
1	BFC	Binh Dien Fertilizer JSC	26	KDH	Khang Dien House Trading and Investment JSC
2	CAV	Vietnam Electric Cable Corporation	27	KSB	Binh Duong Mineral and Construction JSC
3	CII	Ho Chi Minh City Infrastructure Investment JSC	28	LDG	LDG Investment JSC
4	CTD	Coteccons Construction JSC	29	MBB	Military Commercial Joint Stock Bank
5	CTG	Vietnam Joint Stock Commercial Bank For Industry And Trade	30	MWG	Mobile World Investment Corporation
6	CTI	Cuongthuan Idico Development Investment Corporation	31	NBB	577 Investment Corporation
7	DCM	PetroVietnam Ca Mau Fertilizer JSC	32	NKG	Nam Kim Steel JSC
8	DHG	DHG Pharmaceutical JSC	33	NLG	Nam Long Investment Corporation
9	DPM	Petrovietnam Fertilizer and Chemicals Corporation	34	NT2	PetroVietnam Power Nhon Trach 2 JSC
10	DPR	Dong Phu Rubber JSC	35	PDR	Phat Dat Real Estate Development Corp
11	DRC	Danang Rubber JSC	36	PHR	Phuoc Hoa Rubber JSC
12	DXG	Dat Xanh Group JSC	37	PTB	Phu Tai JSC
13	FCN	FECON Corporation	38	PVD	Petrovietnam Drilling & Well Service Corporation
14	GMD	Gemadept Corporation	39	PVT	PetroVietNam Transportation Corporation
15	GTN	GTNFOODS JSC	40	QCG	Quoc Cuong Gia Lai JSC
16	HAG	Hoang Anh Gia Lai JSC	41	REE	Refrigeration Electrical Engineering Corporation
17	HBC	Hoa Binh Construction Group JSC	42	SJD	Can Don Hydro Power JSC
18	HNG	Hoang Anh Gia Lai Agricultural JSC	43	SJS	Song Da Urban & Industrial Zone Investment and Development JSC
19	HPG	Hoa Phat Group JSC	44	SKG	Superdong Fast Ferry Kien Giang JSC
20	HQC	Hoang Quan Consulting – Trading – Service Real Estate Corporation	45	STB	Sai Gon Thuong Tin Commercial Joint Stock Bank
21	HT1	Ha Tien 1 Cement JSC	46	STG	South Logistics JSC
22	IJC	Becamex Infrastructure Development JSC	47	VHC	Vinh Hoan Corporation
23	IMP	Imexpharm Corporation	48	VNM	Vinhomes JSC
24	KBC	Kinh Bac City Development Holding Corporation	49	VSC	Vietnam Container Shipping Joint Stock Corporation
25	KDC	KIDO Group Corporation			

Table I.
49 stock tickers included in the sample

where i denotes stock i and w denotes week w. TPI_{iw} is the average daily turnover price ratios of stock i over week w, normalized to [0;100], $\text{Ln}(\text{SVI}_{i,w-1})$ is the natural logarithm of stock-specific Google SVI of week $w-1$, $\text{Ln}(\text{SVImarket}_{i,w-1})$ is the natural logarithm of market-related Google SVI of week $w-1$, $\text{Ln}(\text{Marketcap}_{i,w-1})$ is the natural logarithm of market capitalization of stock i in VND of week $w-1$, $\text{Sd}(\text{Return}_{i,w-1})$ is the standard deviation of daily returns of week $w-1$ and $\text{Weekvol}_{i,w-1}$ is the VND traded volume of stock i over week $w-1$.

Model I tests the effect of stock-specific and market-related investor attention (natural logarithm of weekly Google Search Index – Ln(SVI) and Ln(SVImarket) on stock illiquidity (weekly average turnover price impact (TPI) ratio), with other variables controlled: firm size, weekly return, weekly return volatility, trading volume in VND and a lag. A lagged time trend is also included to control for changing economic conditions over time.

To avoid interdependence between illiquidity and SVI and other independent variables, we employ a one-week lag for independent variables. We include an interaction variable for firm size and SVI, to control for the potential effect of firm size as suggested by Bank *et al.* (2011): firm size can weaken the impact of investor attention on liquidity, as larger stocks have lower costs of asymmetric information.

Model II:

$$\text{Sd}(\text{Return}_{i,w}) = a_0 + a_1 \times \text{Ln}(\text{SVI}_{i,w}) + a_2 \times \text{Ln}(\text{SVImarket}_{i,w}) + a_3 \times \text{Return}_{i,w} + a_4 \times \text{Sd}(\text{Return}_{i,w-1}) + a_5 \times \text{Weekvol}_{i,w} + a_6 \times w + \varepsilon,$$

where i denotes stock i and w denotes week w. $\text{Sd}(\text{Return}_{i,w})$ is the standard deviation of daily returns of week w, $\text{Ln}(\text{SVI}_{i,w-1})$ is the natural logarithm of stock-specific Google SVI of week $w-1$, $\text{Ln}(\text{SVImarket}_{i,w-1})$ is the natural logarithm of market-related Google SVI of week $w-1$, $\text{Return}_{i,w-1}$ is the cumulative return of stock i over week $w-1$, $\text{Sd}(\text{Return}_{i,w-1})$ is the standard deviation of daily returns of week $w-1$ and $\text{Weekvol}_{i,w-1}$ is the VND traded volume of stock i over week $w-1$.

Model II tests the effect of Ln(SVI) and Ln(SVImarket) on stock volatility (standard deviation of specific stock return in the same week – Sd(Return)), with control variables included: weekly return, weekly trading volume in number of stocks and a lag. A time trend is also included to control for changing economic condition.

To capture the process of information incorporating into stock price, reducing or increasing volatility, the independent variables are in the same week as Sd(Return), except for the lagged Sd(Return).

3.1 Stock illiquidity – TPI variable (Florackis et al., 2011)

Following Florackis *et al.* (2011), we employ TPI ratio to measure illiquidity. We choose TPI instead of Amihud (2002) illiquidity ratio as the primary dependent variable to rule out the size bias and the effect of inflation over time, as our sample includes large differences in firm size, over a period of five years in a developing economy:

$$\text{TPI}_{iw} = \frac{1}{D_{iw}} \sum_{t=1}^{D_{iw}} |R_{iwd}| / \text{Turnover}_{iwd},$$

where R_{iwd} is the stock i's return on day d of week w, Turnover_{iwd} is the proportion of total outstanding shares of stock i traded in day d of week w and D_{iw} is the number of days with available data for stock i in week w.

To better report coefficients from 49 regressions, we normalizes TPI ratio for each stock to a scale of [0;100]. This, however, would not enable comparing TPI ratio among the stocks

with different liquidity. Rather, it would better capture the cross-sectional differences in impact magnitude from independent variables.

We drop outlier observations as follows: the 1st and 100th percentiles are dropped from each of the 49 samples corresponding to 49 stocks, because each stock is only included in one regression against its time series, not against other stocks in bulk.

3.2 Stock volatility – standard deviation of stock returns

Following Aouadi *et al.* (2013), we measures weekly stock volatility by calculating standard deviation in daily stock returns for the days with available data during the week. Similarly, outliers are dropped individually for each stock's time series, leaving out the 1st and 100th percentile in stock return standard deviation:

$$\sigma = \sqrt{\left(\left(\sum (R_d - E(R))^2\right)/D_{iw}\right)},$$

where σ is the standard deviation of stock i's daily return in week w, R_d is the stock i's return in day d of week w, $E(R)$ is the expe*cted* value of stock i's daily return in week w and D_{iw} is the number of days with available data for stock i in week w.

3.3 Control variables

Natural logarithm of VND market capitalization:

$$\mathrm{Ln}\left(\mathrm{Marketcap}_{i,w}\right) = \mathrm{Ln}(\text{Outstanding shares} \times \text{Closing price at the last trading day of week } w).$$

Weekly cumulative return:

$$\mathrm{Return}_{i,w} = \prod \left(1 + \mathrm{Return}_{i,d}\right) - 1,$$

where $\mathrm{Return}_{i,d}$ is the stock i's return in day d of week w.

Weekly traded volume in VND:

$$\mathrm{Weekvol}_{i,w} = \sum \text{Daily traded volume in VND of week } w.$$

3.4 Descriptive statistics

Table II reports descriptive statistics for SVI as provided by Google Trends, before being scaled to the natural logarithmic scale. As the maximum and minimum values are all 0 and 100 respectively, only mean value and standard deviation are provided. Highest average belongs to HAG at 56.84, whereas STG has the lowest average of 12.85. This indicates large variability in search volume among stocks, even after scaled by Google Trends. In addition, the distributions of the 49 time series are all positively skewed. Because of this positive skewness and variability, we further transform firm-specific and market-related SVI to the natural logarithmic scale, aiming to better compare regression coefficients (which represent impact of changes in SVI in each time series).

3.5 Unit root test

We conduct a test for unit root of the three main variables of the models: Ln(SVI), TPI and standard deviation of returns on each of the 49 time series. We employ an augmented Dickey–Fuller test (Dickey and Fuller, 1979), which fit the following model for time series y_t:

$$\Delta y_t = \alpha + \delta_t + \beta y_{t-1} + \sum\nolimits_{(i=1 \to k)} \gamma_i \Delta y_{t-i} + \epsilon_t,$$

where k is the number of lagged difference.

Ticker	Observations	Mean	SD	Skew	Ticker	Observations	Mean	SD	Skew
BFC	256	24.68	16.33	1.178	KDH	253	21.16	18.96	0.711
CAV	252	49.52	15.58	0.164	KSB	250	24.12	21.11	0.796
CII	245	31.68	15.00	1.111	LDG	255	27.71	21.62	0.544
CTD	242	25.26	15.92	1.348	MBB	255	27.07	22.80	1.311
CTG	252	22.06	16.27	1.787	MWG	254	31.28	24.01	0.848
CTI	224	31.64	16.89	0.943	NBB	247	14.86	13.27	2.562
DCM	256	37.29	22.04	0.620	NKG	252	16.96	14.42	1.794
DHG	255	49.42	18.84	0.435	NLG	246	24.56	20.46	0.852
DPM	255	20.00	10.28	2.316	NT2	257	34.19	21.27	0.481
DPR	249	13.24	14.14	1.982	PDR	235	33.74	20.98	0.671
DRC	253	47.55	17.55	0.444	PHR	244	35.36	18.84	0.883
DXG	252	28.53	22.15	1.102	PTB	253	30.55	20.18	0.708
FCN	253	22.12	21.27	1.122	PVD	255	39.64	15.28	0.819
GMD	252	15.66	12.53	2.784	PVT	255	36.00	15.07	0.992
GTN	246	21.67	16.18	1.414	QCG	249	14.82	15.08	1.847
HAG	255	56.84	11.45	0.347	REE	253	46.04	16.47	0.576
HBC	252	21.31	17.18	1.311	SJD	248	20.17	20.76	0.785
HNG	256	39.31	12.73	1.275	SJS	255	34.67	18.91	0.506
HPG	255	23.87	21.17	1.109	SKG	255	25.48	20.27	0.927
HQC	238	31.17	17.58	0.827	STB	255	18.98	14.33	2.023
HT1	252	31.41	18.88	0.594	STG	220	12.85	10.49	2.959
IJC	255	21.38	15.97	1.589	VHC	254	27.15	16.62	1.585
IMP	251	21.30	15.38	2.478	VNM	253	43.00	16.44	0.820
KBC	255	49.02	13.26	0.733	VSC	254	32.59	21.62	0.582
KDC	254	44.43	14.95	0.378					

Table II. Descriptive statistics of Google Search Value Index

The null hypothesis corresponds to $\beta = 0$. In other words, the lagged series (y_{t-1}) cannot explain the change in y_t, other than the effect of lagged changes ($\sum_{(i=1\rightarrow k)}\gamma_i \Delta y_{t-i}$). The alternative hypothesis is stationarity of the series.

The results shown in Table III reject the null hypothesis of a unit root existing in any of the time series, with the exception of TPI ratio of stock ticker KDH. This shows the stationarity of the variables, which enables non-spurious estimations from OLS regressions (see Brooks, 2008). We exclude the ticker "KDH" from only Model I (for TPI ratio)

3.6 Correlation between SVI and trading volume

Table IV shows the correlation between stock-specific and market-related SVI to trading volume in the same week. Almost all stock-specific SVI are correlated with higher trading volume at a 5 percent significance level. This indicates increased trading activity during weeks when a stock attracts more attention. The correlation for market-related SVI is more ambiguous and weaker, mixing between positive and negative relationships. Whereas the firm-level result suggests attention-driven buying or selling, the market-level result suggests potential uncertainty created by market-wide information. This is consistent with the findings of Da *et al.* (2011) and Aouadi *et al.* (2013). We continue to test the effects of these two levels of attention on stock performance with multiple regressions.

4. Multiple regression results

4.1 TPI ratio – regression results for Model I

Table V shows regression results for Model I, only for the main variables and significant coefficients. (Full details are reported in Table AI). KDH is excluded, as the ticker's TPI ratio series does not survive the unit root test. Out of the 48 stocks left in the sample, we find that

Ticker	TPI	SdReturn	Ln(SVI)	Ticker	TPI	SdReturn	Ln(SVI)
BFC	−11.375***	−11.142***	−11.853***	KDH	*0.736*	−11.926***	−9.306***
CAV	−8.272***	−9.377***	−14.383***	KSB	−11.787***	−13.553***	−9.756***
CII	−12.342***	−12.506***	−10.712***	LDG	−5.673***	−11.294***	−7.656***
CTD	−14.123***	−11.452***	−7.771***	MBB	−7.514***	−10.604***	−5.698***
CTG	−8.098***	−10.329***	−5.838***	MWG	−7.575***	−13.854***	−5.746***
CTI	−8.136***	−10.683***	−13.603***	NBB	−11.104***	−12.193***	−12.172***
DCM	−7.994***	−9.127***	−12.358***	NKG	−15.613***	−12.419***	−7.671***
DHG	−10.829***	−12.111***	−9.718***	NLG	−14.923***	−12.212***	−8.578***
DPM	−10.180***	−10.689***	−11.584***	NT2	−7.290***	−12.431***	−13.363***
DPR	−18.040***	−11.034***	−8.154***	PDR	−14.265***	−12.283***	−10.306***
DRC	−12.109***	−10.935***	−11.447***	PHR	−13.152***	−13.104***	−11.221***
DXG	−6.636***	−12.666***	−6.406***	PTB	−15.051***	−12.773***	−9.781***
FCN	−11.181***	−11.905***	−9.032***	PVD	−8.016***	−10.977***	−9.604***
GMD	−7.767***	−13.671***	−10.833***	PVT	−7.048***	−13.234***	−13.411***
GTN	−7.427***	−9.277***	−9.922***	QCG	−30.129***	−11.386***	−6.414***
HAG	−10.354***	−11.642***	−8.352***	REE	−7.659***	−12.537***	−8.850***
HBC	−7.034***	−11.908***	−5.418***	SJD	−14.420***	−14.924***	−6.215***
HNG	−25.013***	−9.164***	−10.655***	SJS	−14.672***	−14.085***	−12.586***
HPG	−7.128***	−12.632***	−5.561***	SKG	−10.652***	−12.667***	−8.429***
HQC	−8.219***	−13.259***	−10.289***	STB	−8.468***	−12.186***	−6.379***
HT1	−10.498***	−13.404***	−13.472***	STG	−14.528***	−7.339***	−10.697***
IJC	−9.007***	−11.843***	−10.352***	VHC	−11.338***	−13.803***	−11.527***
IMP	−15.232***	−11.549***	−8.600***	VNM	−8.544***	−12.177***	−7.034***
KBC	−7.349***	−12.448***	−9.902***	VSC	−13.541***	−12.297***	−14.171***
KDC	−8.976***	−13.126***	−6.232***				

Notes: *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table III.
Augmented Dickey–Fuller (ADF) test results of Ln(SVI), TPI and standard deviation of returns

Ticker	Stock-specific	Market-related	Ticker	Stock-specific	Market-related
BFC	0.5312*	−0.1287*	KDH	0.3375*	0.2604*
CAV	0.1676*	−0.0875	KSB	0.5056*	−0.0905
CII	0.4892*	−0.1837*	LDG	0.7594*	0.2464*
CTD	0.7022*	0.2718*	MBB	0.8909*	0.5227*
CTG	0.8982*	0.4868*	MWG	0.8029*	0.3748*
CTI	0.1029	0.0856	NBB	0.1817*	−0.0103
DCM	0.3757*	−0.0898	NKG	0.5162*	0.0628
DHG	0.5258*	0.2238*	NLG	0.5832*	0.1746*
DPM	0.5645*	0.104	NT2	0.4560*	−0.1765*
DPR	0.2497*	0.1341*	PDR	0.4828*	0.3638*
DRC	0.3051*	0.1219	PHR	0.6158*	0.0656
DXG	0.8322*	0.4426*	PTB	0.4979*	0.0561
FCN	0.4132*	0.1505*	PVD	0.4996*	0.0229
GMD	0.2933*	0.1447*	PVT	0.3801*	0.0157
GTN	0.3656*	−0.2008*	QCG	0.6443*	0.4244*
HAG	0.3164*	0.1748*	REE	0.6197*	0.1585*
HBC	0.7413*	0.0243	SJD	0.4072*	0.2330*
HNG	0.3762*	0.1374*	SJS	0.3035*	−0.0087
HPG	0.8024*	0.3909*	SKG	0.5018*	−0.1298*
HQC	0.4354*	−0.2326*	STB	0.8482*	0.3427*
HT1	0.3168*	−0.0223	STG	0.2321*	−0.1553*
IJC	0.5563*	0.1083	VHC	0.4332*	0.4179*
IMP	−0.1049	0.0882	VNM	0.6491*	0.1121
KBC	0.1254*	−0.0055	VSC	0.2784*	0.0461
KDC	−0.009	−0.1697*			

Note: *Significant at 5 percent level

Table IV.
Correlation between weekly stock-specific and market-related SVI to trading volume in the same week

No.	Ticker	Ln(SVI)	Ln (SVImarket)	Adj. R^2	No.	Ticker	Ln(SVI)	Ln (SVImarket)	Adj. R^2
(1)	BFC		0.114**	0.108	(25)	KDC			0.466
(2)	CAV			0.040	(26)	KSB	−3.667***		0.121
(3)	CII			0.078	(27)	LDG	−15.92**	0.226**	0.499
(4)	CTD			0.110	(28)	MBB			0.428
(5)	CTG			0.404	(29)	MWG		0.141**	0.541
(6)	CTI		0.222***	0.444	(30)	NBB			0.052
(7)	DCM			0.249	(31)	NKG			0.028
(8)	DHG	−21.76***		0.303	(32)	NLG		−0.0839*	0.179
(9)	DPM		0.135**	0.214	(33)	NT2			0.417
(10)	DPR			0.094	(34)	PDR			0.078
(11)	DRC			0.071	(35)	PHR	14.90**		0.239
(12)	DXG	14.84**	0.154***	0.615	(36)	PTB	−4.217***		0.124
(13)	FCN			0.190	(37)	PVD		0.284***	0.430
(14)	GMD	27.64*	0.0840*	0.427	(38)	PVT		0.166***	0.482
(15)	GTN			0.357	(39)	QCG			0.111
(16)	HAG		0.108**	0.226	(40)	REE		0.258***	0.510
(17)	HBC		0.0792*	0.553	(41)	SJD			0.041
(18)	HNG	8.964***		0.575	(42)	SJS			0.506
(19)	HPG		0.0926**	0.470	(43)	SKG	−10.13***	0.0688*	0.232
(20)	HQC	−1.662*		0.818	(44)	STB			0.396
(21)	HT1			0.274	(45)	STG		−0.147**	0.279
(22)	IJC		0.126***	0.240	(46)	VHC	5.843***		0.425
(23)	IMP			0.047	(47)	VNM	−46.55***	0.104*	0.496
(24)	KBC	11.38***	0.0792**	0.524	(48)	VSC			0.187

Notes: Only coefficients with at least 10 percent significance level and attention variables are presented, full details are reported in Table AI. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table V.
The impact of investor attention on stock illiquidity

26 stocks have at least one significant (at 90% confidence level) coefficient for Ln(SVI) or Ln (SVImarket) on illiquidity. Among the significant coefficients, company-level attention show mixed results between positive and negative, whereas market-wide attention is consistently positive across the stocks. These results are checked for robustness using an alternative measure of illiquidity: Amihud (2002) illiquidity ratio. We run a similar regression model to Model I using this alternative proxy. The regression yields similar results (see Table AIV).

The consistent positive effect of market GSV can be attributed to uncertainty that investors face when presented with market-wide information following or preceding a search, leading to decreased liquidity. This is consistent with the arguments and findings by Aouadi *et al.* (2013). Similarly, as investors are presented with news covering the whole market and many alternatives, investors' demand on information increases (Vlastakis and Markellos, 2012). Investors may face uncertainty among many options presented to them in their market-wide search. Or they may face the choice among many stocks first, and then decide to do further market research after. Either way, whether causing uncertainty or signaling uncertainty, attention on the market as a whole still magnifies price impact of trade.

Regarding stock-specific SVI, not only are the results of Ln(SVI) mixed, but the same applies to the interaction variable between firm size and SVI (size × SVI – see Table AI). According to Bank *et al.* (2011), the coefficient signs should be negative, because increased attention can be considered as a reduction in asymmetric information costs. Accordingly, firm size should weaken the impact of investor attention on liquidity, as larger stocks have lower costs of asymmetric information. For an extreme expression: the market already knows about the blue-chip stocks. Only the small caps offer information gaps for attention to fill in. Aouadi *et al.*'s (2013) findings in France support this view. However, the regression

results in Table V do not show negative or insignificant effects, but significant mixed effects instead. Specific stocks during periods with high attention can still see larger price impact than normal. However, firm size mitigates this, as all the stocks with positive SVI coefficients are ones that report the opposite interaction variable coefficient sign (see Table AI). This, together with consistent positive correlation between stock attention and traded volume in Table IV, suggests increased trading and reduced liquidity (larger price sentiment) at the same time in some cases. This happens when large price impacts follows attention-driven buying or selling of specific stocks.

One interpretation is that, being an underdeveloped market, Vietnam stock market is still less transparent compared to markets like France. As a result, some stocks listed there may be more vulnerable to market inefficiencies than others. When it comes to these specific stocks, individual investors who lack transparent information but are still attentive can be affected by inefficiencies such as herding, rather than well-grounded information. They can follow foreign investors' net purchase of one stock, or the market's large sell volume as a whole, considering that others may have access to insider information they do not have. This overreaction may cause larger price sentiment driven by increased attention as part of the results indicated. However, evidenced by the opposite interaction effect with size, as these firms grow larger, the inefficiency is mitigated by lowered asymmetric information costs, consistent with the argument by Bank *et al.* (2011).

For the cases that are consistent with consensus view – increased search volume indicates higher liquidity – the reasoning is as follows. When more investors search for information about a stock, they actually acquire useful information and may eventually buy or sell that stock. This leads to increased liquidity of the stock. This is consistent with the conclusion of Ding and Hou (2015) and Aouadi *et al.* (2013).

The effects of attention are tested after controlling for known determinants of liquidity as specified in Model I (detailed are results reported in Table AI). Whereas weekly returns and trading volume remain limited in impacts, other factors exhibit effective control for the model. Historical illiquidity (weekly lagged TPI ratio) positively drives current liquidity throughout most of the stocks. Meanwhile, volatility and time trend during 2014–2018 exhibit reductive effects which are significant on roughly 20 stocks each. For explanatory power, 23 out of 48 regressions show an adjusted R^2 of more than 30 percent, with the highest being HQC at 81.8 percent.

These results confirm *H2* that attention to market as a whole increases stock illiquidity, but only partly confirm *H1* that attention to a specific stock reduces its illiquidity by promoting trading activities.

4.2 Stock price volatility – regression results for Model II

Table VI shows regression results for Model II, only for the main variables and significant coefficients (full details are reported in Table AII). Out of the 49 stocks, 34 show at least one significant coefficient of Ln(SVI) or Ln(SVImarket) at the 90 percent significant level. Whereas stock SVI again sees mixed signs, market SVI is positively related to stock return standard deviation for all the relevant stock.

First, we examine the impact of market-related attention. The interpretation for increased volatility is similar to that of decreased liquidity: attention to a large set of alternatives – the market – may not actually provide risky situations with more information. Instead, it presents even more uncertainty, as the investors get to know how much they do not know. The general information of the market as a whole is usually not specific enough for decision. Aouadi *et al.* (2013) reason that market-wide SVI reflects the uncertainty-driven excessive transaction, fluctuating prices. Meanwhile, the mixed result on firm-specific SVI is consistent with the two arguments proposed by Aouadi *et al.* (2013). On the one hand, attention reduces uncertainty and, therefore, decreases volatility. Attention helps investors

No.	Ticker	Ln(SVI)	Ln (SVImarket)	Adj. R^2	No.	Ticker	Ln(SVI)	Ln (SVImarket)	Adj. R^2
(1)	BFC		0.284**	0.137	(26)	KDH	0.438**	0.261*	0.215
(2)	CAV		−0.0654	0.275	(27)	KSB		0.511***	0.160
(3)	CII	0.228*	0.251**	0.211	(28)	LDG		0.342*	0.074
(4)	CTD		0.219**	0.207	(29)	MBB			0.323
(5)	CTG	0.325*		0.328	(30)	MWG		0.417***	0.148
(6)	CTI		0.470***	0.222	(31)	NBB		0.269*	0.149
(7)	DCM		0.315**	0.299	(32)	NKG		0.356**	0.139
(8)	DHG	−0.421***	0.182*	0.242	(33)	NLG		0.468***	0.182
(9)	DPM		0.276***	0.341	(34)	NT2		0.331***	0.191
(10)	DPR			0.164	(35)	PDR			0.158
(11)	DRC		0.443***	0.311	(36)	PHR			0.085
(12)	DXG			0.216	(37)	PTB	0.252*	0.288***	0.175
(13)	FCN		0.350***	0.273	(38)	PVD		0.431***	0.308
(14)	GMD		0.360***	0.184	(39)	PVT		0.222**	0.226
(15)	GTN		0.377***	0.264	(40)	QCG	0.417*		0.137
(16)	HAG	1.398***		0.244	(41)	REE			0.197
(17)	HBC	0.307**	0.244**	0.139	(42)	SJD			0.226
(18)	HNG	0.695*		0.124	(43)	SJS	0.470***	0.204*	0.136
(19)	HPG	0.207*	0.218*	0.171	(44)	SKG			0.117
(20)	HQC			0.125	(45)	STB			0.125
(21)	HT1			0.181	(46)	STG			0.406
(22)	IJC	0.307**		0.184	(47)	VHC		0.281*	0.147
(23)	IMP			0.221	(48)	VNM			0.102
(24)	KBC	0.797***	0.327***	0.192	(49)	VSC		0.343***	0.198
(25)	KDC	−0.460**	0.264***	0.250					

Notes: Only coefficients with at least 10 percent significance level and attention variables are presented, full details are reported in Table AII. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table VI.
The impact of investor attention on stock volatility

base their trading decision on facts rather than herding. This can keep stock price at its intrinsic value, being less vulnerable to fluctuations, leaving smaller gaps for arbitrage. On the other hand, new information manifests into the new prices, constantly correcting it, spiking the price charts, increasing volatility.

These effects are tested while controlling for other determinants of volatility (see Table AII for details). The two factors that show the most persistent link with volatility is trading volume and lagged volatility, both showing significant positive impacts throughout most of the stocks examined. Whereas trading volume drives quicker price changes, short-term historical volatility also explains current volatility of stocks. Meanwhile, the effect of returns exhibit significance only in half of the stocks, being persistently positive. The same applies to time trend during the period of 2014–2018, but in the opposite direction. Adjusted R^2 ranges from 7.4 percent to a maximum of 40.6 percent, for the case of STG.

These results confirm *H4* that attention to market as a whole increases stock volatility, but only partly confirm *H3* that attention to a specific stock reduces its volatility.

5. Conclusion

This paper contribute to the strand of literature on GSV and stock market first by providing evidence on Vietnam, a developing economy; and second, by quantifying the relationship between stock-specific performance and the attention paid on each stock individually, rather than search-based sentiment on Vietnam stock market as a whole, as previously examined by Nguyen and Pham (2018).

We find significantly positive impact of attention to market as a whole on stock illiquidity and volatility. Meanwhile, our findings on attention to each company report

impacts of both directions on illiquidity and volatility. Market-related attention brings about more uncertainty and information demand, resulting in excessive trading activity, fluctuating prices. Regarding firm-specific attention in Vietnam, our findings suggest the existence of trading behaviors that are not well-grounded in facts, a trait more prevalent among less transparent markets like Vietnam.

Some limitations of this paper are as follows. Google Trends data for Vietnam still lack detailed classification and coverage of keywords. Combined with our limited coverage of the stocks, this leaves out many stock tickers with large market capitalizations. Also, with search volume being automatically scaled by Google Trends, and the maximum time span for weekly data being five years, fewer comparisons can be made, limiting the usefulness of GSV compared to traditional measures.

Notes

1. According to StatCounter GlobalStats, available at gs.statcounter.com
2. World Telecommunication/ICT Indicators Database, 20th Edition, 2016, available at: http://handle.itu.int/11.1002/pub/80d23b7d-en
3. According to Vietnam Securities Depository, as of January 31, 2019.
4. According to Ho Chi Minh Stock Exchange as of January 2, 2019.

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Table AI.
Model I regression results – turnover price impact ratio

Ticker	SVI	SVI market	Lag_ TPI	Size	Size×SVI	Week return	Returnsd	Weekvol	Lag_ time	Constant	*n*	Adj. R^2
BFC	4.484	0.114**	0.166	7.953	−0.213	0.230	−0.303	−0.0265	−0.00774	−167.8	147	0.108
CAV	3.033	0.0465	−0.0230	4.609	−0.140	0.0399	−0.496	−0.0552	0.00374	−98.61	190	0.040
CII	0.674	0.0419	0.103**	4.569	−0.0273	0.155	−1.699***	0.00109	−0.036***	−97.76	231	0.078
CTD	3.472	0.0216	0.0415	−4.739	−0.151	−0.00456	−1.292*	0.00238	−0.00180	109.0	224	0.110
CTG	−1.475	0.0714	0.316***	−19.25	0.0546	−0.458***	−1.478*	0.00196	−0.040***	493.9	242	0.404
CTI	−3.586	0.222***	0.0664	−20.91***	0.176	−0.217	−3.071***	0.0509	−0.0727**	436.9***	195	0.444
DCM	11.49	0.0725	0.307***	−25.35	−0.515	0.0426	−0.469	−0.0236	−0.118**	597.8	147	0.249
DHG	−21.76***	0.0636	0.261***	−51.16***	0.954***	−0.0393	−1.293	−0.00714	−0.0478***	1,179***	248	0.303
DPM	7.619	0.135**	0.236***	30.03*	−0.326	−0.170	0.323	−0.0359	0.0681**	−688.1*	248	0.214
DPR	1.831	0.0495	0.0126	−21.69***	−0.0859	−0.204	0.561	−0.0277	−0.0292***	462.2***	236	0.094
DRC	1.817	0.0377	0.0559	6.278	−0.0844	−0.0328	−0.534	−0.0173	−0.00473	−133.3	244	0.071
DXG	14.84**	0.154***	0.657***	14.21**	−0.706**	−0.343***	−2.894***	0.00332	−0.00822	−292.1**	241	0.615
FCN	1.253	−0.0221	0.186***	−5.219	−0.0605	−0.177	−0.892	−0.0142	−0.0107	116.0	244	0.190
GMD	27.64*	0.0840*	0.283***	7.692	−1.260*	−0.487**	−2.554**	−0.0284**	−0.0483***	−147.0	244	0.427
GTN	−3.830	0.0744	0.426***	−1.865	0.182	0.0225	−0.677	−0.00192	0.0127	41.60	180	0.357
HAG	0.921	0.108**	0.238***	−2.152	−0.0387	−0.210	−0.868	−0.0144**	−0.0481	66.08	247	0.226
HBC	−5.386	0.0792*	0.619***	−1.638	0.251	−0.200*	−2.085***	0.00303	−0.0372	44.60	243	0.553
HNG	8.964***	0.0121	0.0593**	33.04***	−0.403***	6.34e-05	0.154	−0.00952***	0.000193	−732.7***	148	0.575
HPG	−4.367	0.0926**	0.296***	−1.850	0.183	−0.208	−1.586*	−0.000723	−0.0597***	56.91	247	0.470
HQC	−1.662*	−0.00296	0.877***	−3.804***	0.0799*	−0.115***	−1.572***	0.0278***	−0.00366	78.56***	215	0.818
HT1	2.831	0.0204	0.450***	10.68**	−0.126	0.0429	−0.421	−0.0242	−0.0195**	−235.6**	243	0.274
IJC	3.886	0.126***	0.333***	3.751	−0.179	−0.275**	−0.882	0.00859	0.00558	−82.50	233	0.240
IMP	−3.461	0.0426	0.0313	−9.077	0.168	0.219	−0.405	−0.0694	0.0354*	187.1	241	0.047
KBC	11.38***	0.0792**	0.318***	23.34***	−0.502***	−0.0482	−2.415***	−0.00371	−0.0102	−522.6***	247	0.524
KDC	1.836	0.0371	0.342***	3.538	−0.0826	−0.0319	−1.694***	0.00304	−0.00704	−75.77	245	0.466
KSB	−3.667***	−0.0150	0.231***	−2.191	0.174***	0.0570	1.240**	−0.0197	−0.00848	47.13	238	0.121
LDG	−15.92**	0.226**	0.320***	−18.17	0.804**	−0.135	−2.373*	−0.0652*	−0.170***	410.0	145	0.499
MBB	−1.800	0.0542	0.284***	11.50	0.0698	−0.121	−1.344*	−0.000867	0.00837	−264.1	247	0.428
MWG	−6.536	0.141**	0.273***	−4.145	0.276	−0.469***	−0.905	−0.00544	−0.122***	121.3	195	0.541
NBB	−0.455	−0.000437	0.103*	0.517	0.0221	0.0147	0.291	−0.0527	0.00963	−9.591	233	0.052
NKG	−1.223	−0.0117	0.0542	1.113	0.0570	−0.0529	0.284	−0.00640	−0.00978	−20.91	241	0.028

(*continued*)

Table AI.

Ticker	SVI	SVI market	Lag_ TPI	Size	Size×SVI	Week return	Returnsd	Weekvol	Lag_ time	Constant	n	Adj. R^2
NLG	5.241	−0.0839*	−0.0889	−22.16***	−0.240	−0.309*	0.572	−0.00681	0.0369*	480.7***	232	0.179
NT2	0.284	0.00958	0.494***	5.965	−0.0127	−0.0156	−2.350**	0.0219	0.0510*	−140.2	149	0.417
PDR	−1.599	0.00295	−0.0151	−5.027***	0.0738	0.0118	0.292*	−0.00235	0.00167	108.4***	222	0.078
PHR	14.90**	0.0577	0.00462	26.47**	−0.696**	−0.0996	1.928***	−0.0323	−0.0626***	−557.5**	227	0.239
PTB	−4.217***	−0.00436	0.256***	−3.632	0.199***	0.0465	−0.466	−0.00212	−0.0113	79.88	243	0.124
PVD	4.245	0.284***	0.131*	11.96*	−0.189	−0.0862	0.212	−0.00589	−0.0683**	−254.4*	247	0.430
PVT	−10.69	0.166***	0.299***	−17.56	0.491	−0.319**	−1.567**	−0.0208	0.0414***	385.7	247	0.482
QCG	−1.119	0.00275	0.179***	−0.0364	0.0524	0.0204	−0.294	−0.0274	0.0138*	2.061	237	0.111
REE	2.069	0.258***	0.340***	−16.57	−0.0969	−1.138***	−1.694	−0.0330**	0.00999	393.8	245	0.510
SJD	5.305	−0.00653	−0.0315	7.868	−0.255	−0.335	−0.203	−0.0499	−0.0234*	−157.3	234	0.041
SJS	−2.224	−0.00171	0.556***	2.342	0.103	0.191***	−0.922***	0.0343*	−0.00517	−50.26	247	0.506
SKG	−10.13***	0.0688*	−0.0296	−12.61***	0.474***	−0.0691	0.465	−0.0434	−0.0483***	278.9***	198	0.232
STB	12.97	0.0151	0.275***	−2.113	−0.552	−0.225	−1.376**	0.00118	−0.0343**	62.55	247	0.396
STG	10.17	−0.147**	0.123	−10.84**	−0.502	0.0197	1.104	−0.0691	0.0710*	212.2**	163	0.279
VHC	5.843***	−0.0496	0.578***	−1.032	−0.264***	0.00230	−0.575	0.0238	0.0256**	21.40	245	0.425
VNM	−46.55***	0.104*	0.158*	−105.6***	1.802***	−0.0518	−0.0215	−0.00347	0.0349*	2,729***	243	0.496
VSC	−0.475	0.00445	0.255***	−3.144	0.0222	−0.112	−0.912	−0.00296	−0.00589	70.67	245	0.187

Notes: *,**,***Significant at 10, 5 and 1 percent levels, respectively

Appendix 2

Table AII.
Model II regression results – standard deviation of stock returns

	lnSVI	lnSVImarket	Weekreturn	Lag_returnsd	Weekvol	time	Constant	n	Adj. R^2
BFC	0.206	0.284**	0.0334*	0.145*	0.00457	−0.00371**	0.359	153	0.137
CAV	−0.283	−0.0654	0.00617	0.235***	0.0171***	0.000972	2.044**	187	0.275
CII	0.228*	0.251**	0.0471***	0.153**	0.00195***	−2.08e−05	−0.549	235	0.211
CTD	−0.0811	0.219**	0.0286**	0.295***	0.00392***	−0.0032***	0.807*	236	0.207
CTG	0.325*	−0.0182	0.0284**	0.248***	0.00143***	−0.00175*	0.298	222	0.328
CTI	0.0967	0.470***	0.0205	0.176**	0.00408**	−0.0063***	0.440	211	0.222
DCM	0.0398	0.315**	0.0368*	0.129*	0.00470***	0.00214	−0.599	175	0.299
DHG	−0.421***	0.182*	0.0385***	0.153***	0.00660***	−0.000345	2.032***	247	0.242
DPM	0.146	0.276***	0.0346***	0.144**	0.00397***	0.00216***	−0.924***	245	0.341
DPR	−0.163	−0.203	0.0434**	0.324***	0.00374	0.000344	1.978***	161	0.164
DRC	−0.0993	0.443***	0.0378***	0.208***	0.00686***	0.00174**	−0.255	243	0.311
DXG	0.110	0.0879	−0.00331	0.114*	0.00215***	−0.00204*	1.156**	223	0.216
FCN	−0.0315	0.350***	0.0108	0.112	0.00833***	7.62e−05	0.0489	181	0.273
GMD	0.0272	0.360***	0.0494***	0.0544	0.00288***	−0.000499	0.144	235	0.184
GTN	0.0933	0.377***	0.0258*	0.296***	0.00454***	−0.000909	−0.339	169	0.264
HAG	1.398***	−0.0975	0.00607	0.110*	0.00202***	0.00591***	−4.770***	223	0.244
HBC	0.307**	0.244**	0.0273**	0.196***	6.66e−05	−0.00348**	0.502	233	0.139
HNG	0.695*	−0.147	0.0300*	0.187**	0.00152	0.00109	−0.394	144	0.124
HPG	0.207*	0.218*	0.0208	0.0260	0.000826**	−0.0070***	0.882**	164	0.171
HQC	0.102	0.100	0.0218	0.0426	0.00414***	−0.00166	1.052*	225	0.125
HT1	0.117	0.174	0.0120	0.0499	0.0139***	0.000819	0.451	205	0.181
IJC	0.307**	0.233	0.0329*	0.180***	0.00330*	−0.000171	−0.180	199	0.184
IMP	0.115	0.175	0.0346*	0.222***	0.0426***	−0.00170*	0.271	235	0.221
KBC	0.797***	0.327***	0.00301	0.0814	0.00103**	−0.0023***	−2.241**	239	0.192
KDC	−0.460**	0.264***	0.0240*	0.0689	0.00339***	0.000108	1.988**	239	0.250
KDH	0.438**	0.261*	0.0271	0.0787	0.0106***	−0.00226**	−0.972	157	0.215
KSB	0.0786	0.511***	0.0298*	0.0392	0.00541***	−0.000744	−0.404	180	0.160
LDG	0.0287	0.342*	−0.00361	0.0387	0.00399*	−0.00421*	1.910**	136	0.074
MBB	0.174	−0.0593	0.0531***	0.222***	0.00110***	−0.00141*	0.626*	214	0.323
MWG	0.153	0.417***	0.0533***	0.0619	0.00162**	−0.0054***	0.381	214	0.148
NBB	0.00835	0.269*	0.0515**	0.191***	0.0140***	0.000611	0.439	200	0.149
NKG	0.175	0.356**	0.0188	0.168**	0.00178	−0.0049***	0.913	196	0.139
NLG	0.121	0.468***	−0.0132	0.115	0.00697***	−0.0032***	−0.389	185	0.182

(continued)

Table AII.

	lnSVI	lnSVImarket	Weekreturn	Lag_returnsd	Weekvol	time	Constant	n	Adj. R^2
NT2	0.153	0.331***	0.0254	0.157**	0.00220**	−0.0027***	0.00340	208	0.191
PDR	0.213	0.210	0.0211	0.164**	0.00220*	−0.0058***	0.593	209	0.158
PHR	−0.0546	−0.0508	0.0267	0.142**	0.00302	0.00141	1.697**	231	0.085
PTB	0.252*	0.288***	0.0419***	0.110*	0.00609**	−0.0044***	0.226	214	0.175
PVD	−0.190	0.431***	0.00909	0.0941	0.00414***	0.00218**	0.122	210	0.308
PVT	−0.0278	0.222**	0.0408***	0.0132	0.00606***	−0.00142	1.075**	238	0.226
QCG	0.417*	−0.227	0.0138	0.0680	0.00784**	−0.000175	1.846**	138	0.137
REE	0.125	0.110	0.0168	0.125**	0.00208***	0.00154**	−0.0251	242	0.197
SJD	−0.169	0.159	0.00681	−0.0987	0.0435***	−0.0040***	1.687**	131	0.226
SJS	0.470***	0.204*	0.0198	0.00493	0.00670**	−0.000167	−0.476	221	0.136
SKG	−0.0742	0.157	0.0472***	0.167**	0.0108**	−0.00136	1.166**	204	0.117
STB	0.202	0.107	0.0274*	0.188***	0.000704	0.000485	0.478	222	0.125
STG	−0.0124	0.159	0.0264	0.169**	0.0205***	−0.0138***	3.676***	131	0.406
VHC	0.138	0.281*	0.0268*	−0.0500	0.00684***	−3.81e−05	0.620	227	0.147
VNM	0.176	0.119	0.0172	0.140**	0.000949***	−0.00272**	−0.0278	201	0.102
VSC	0.166	0.343***	0.0411***	0.167**	0.00797***	−0.00112	−0.398	217	0.198

Notes: *,**,***Significant at 10, 5 and 1 percent levels, respectively

Appendix 3

Table AIII.
Excluded stock tickers from VN-100 due to different meanings as search queries

Ticker	Other meanings as search terms
BMP	Bitmap
FPT	Company name
GAS	Gas
HSG	*Hoc sinh gioi*
MSN	A Microsoft website
PNJ	Company name
ROS	Rules of Survival (Video game)
SAB	Triangle notation (Math)
SBT	*Sach bai tap*
SSI	Company name – stock broker
VCB	Bank name
VIC	Taxi, cosmetic products
AAA	Battery name
ASM	Assembly programming language
BIC	Supermarket BIGC, company name
BMI	Body mass index
CHP	*CH Play*
CSM	Server Software
CSV	File extension
DIG	Dig, dig a way (Video game)
DMC	Devil may cry (Video game)
EIB	Bank name
FIT	English word, Samsung gear fit
FLC	Company name
ITA	*Italy*, *bokura ga ita* (song)
LIX	Popular detergent name
NCT	*Nhaccuatui* (popular music site)
NSC	NCS (popular music label)
PAC	*Pac bo*, *krong pac*, *pacman*
PAN	English word
PGI	Sound system, video game championship
POM	Dog breed, company product (*Pomina*)
PPC	Pay per click (advertising term)
SAM	Samsung, English name
SCR	Motorcycle model

Appendix 4

Table AIV. Model I robustness check – alternative illiquidity measure regression: Amihud illiquidity ratio

Ticker	SVI	SVI market	Lag_amihud	size	size × SVI	Week return	returnsd	Weekvol	Lag_time	Constant	n	Adj. R^2
BFC	4.372	0.108**	0.203	8.285	−0.208	0.231	−0.367	−0.0209	−0.00648	−175.0	147	0.111
CAV	3.866	0.0492	−0.0321	6.014	−0.180	0.0361	−0.328	−0.0593	−0.00506	−127.1	190	0.042
CII	0.484	0.0364	0.0968**	5.334*	−0.0188	0.129	−1.679***	0.00170	−0.0358***	−115.2*	244	0.084
CTD	9.238***	−0.0248	−0.196***	−3.043	−0.404***	−0.220	−0.254	0.00639	−0.00673	70.31	243	0.181
CTG	−9.574	0.0739	0.324***	−27.59	0.381	−0.415**	−1.378*	0.00150	−0.0415***	699.1*	236	0.438
CTI	−6.818***	0.00960	0.106	−26.94***	0.333***	−0.209	0.463	0.00555	0.0111	549.1***	190	0.442
DCM	10.18	0.0676	0.323***	−28.26	−0.457	0.0209	−0.449	−0.0234	−0.114**	662.0	147	0.258
DHG	−21.71***	0.0625	0.216***	−56.56***	0.951***	−0.0658	−1.155	−0.00438	−0.0388***	1,300***	248	0.321
DPM	3.722	0.154***	0.201***	16.82	−0.157	−0.151	−0.0450	−0.0271	0.0744***	−390.6	248	0.406
DPR	0.843	0.0441	−0.0264	−20.99***	−0.0394	−0.173	0.498	−0.0232	−0.0261***	446.9***	237	0.100
DRC	1.680	0.0408	0.0497	4.584	−0.0783	−0.0415	−0.480	−0.0184	−0.00339	−96.21	244	0.057
DXG	10.98*	0.107**	0.628***	8.308	−0.521*	−0.284***	−2.074***	0.000537	−0.0197	−168.2	247	0.625
FCN	1.770	−0.00996	0.195***	−6.970	−0.0857	−0.192	−0.938	−0.0176	−0.00989	152.3	247	0.199
GMD	17.96	0.0826*	0.317***	−2.400	−0.820	−0.496***	−2.325**	−0.0231*	−0.0431***	70.55	244	0.459
GTN	−1.652	0.0247	0.750***	−2.678	0.0792	−0.0130	−0.454*	−0.000378	0.00503	56.53	196	0.546
HAG	−2.944	0.127**	0.576***	−18.53**	0.130	−0.204	−1.672**	−0.00833	−0.0528*	437.2**	243	0.576
HBC	−4.538	0.0548	0.500***	−1.370	0.211	−0.146	−1.438***	0.00260	−0.0277	35.47	246	0.610
HNG	19.14***	−0.00574	0.408*	66.64***	−0.860***	0.0663	−0.174	−0.00430	0.0285	−1,486***	149	0.417
HPG	−4.524	0.0904*	0.255***	−6.712	0.190	−0.329**	−1.106	−0.00252	−0.0539***	172.7	219	0.493
HQC	−2.583**	−0.0159	0.654***	−1.723	0.126**	−0.237***	−1.554***	0.0285***	−0.00692	34.44	243	0.690
HT1	0.467	0.0184	0.0637	2.217	−0.0212	0.0268	−0.0906	−0.00788	−0.00713	−48.52	245	0.025
IJC	3.908	0.126***	0.286***	2.176	−0.180	−0.270**	−1.000*	0.0185	0.00166	−49.03	233	0.270
IMP	−3.187	−0.0193	−0.00438	−12.42**	0.152	−0.00641	0.362	−0.0804	0.0327**	259.1**	244	0.035
KBC	10.73***	0.0725***	0.478***	23.13***	−0.474***	−0.0783	−1.938***	−0.000416	−0.00839	−520.7***	247	0.680
KDC	−0.230	0.0722*	0.315***	1.166	0.00569	−0.0174	−1.722**	−0.00127	0.00140	−19.74	243	0.428
KSB	−0.857	−0.0289	0.928***	−0.959	0.0403	−0.0182	0.328	−0.00379	0.00542	20.04	238	0.454
LDG	−14.73*	0.170*	0.341***	−30.66**	0.746*	−0.202	−2.239*	−0.104***	−0.219***	668.6**	149	0.565
MBB	−2.435	0.0461	0.275***	6.157	0.0978	−0.133	−1.466**	−0.00239	0.00411	−137.4	245	0.425
MWG	−7.547	0.144**	0.458***	−11.26*	0.320	−0.538**	−1.166	−0.00427	−0.105***	285.2**	195	0.620
NBB	−0.444	−0.0253	0.198***	0.0835	0.0213	0.108	0.458	−0.0594*	0.00376	0.251	236	0.074

(continued)

Table AIV.

Ticker	SVI	SVI market	Lag_amihud	size	size × SVI	Week return	returnsd	Weekvol	Lag_time	Constant	*n*	Adj. R^2
NKG	0.230	0.0305	0.477***	−6.032	−0.0133	−0.195	−0.918	−0.00904	0.0189	127.7	246	0.461
NLG	2.581	0.0147	−0.0322	−3.017	−0.118	−0.328***	0.603	0.00299	−0.00919	66.04	236	0.125
NT2	−0.000580	4.05e-05	0.837***	0.0154	2.44e-05	−1.98e-05	−0.00726**	6.45e-05	0.000152	−0.366	149	0.453
PDR	1.427	0.0464	0.787***	0.954	−0.0660	−0.247**	−0.509	0.00274	−0.0204	−17.85	226	0.500
PHR	4.325	0.0101	−0.0234	3.405	−0.202	−0.101	0.701	−0.0132	−0.0243***	−69.00	231	0.093
PTB	−4.203***	−0.00603	0.238***	−3.662	0.198***	0.0438	−0.405	−0.00439	−0.0105	80.42	245	0.134
PVD	0.0428	0.133***	0.627***	−1.684	−0.00453	−0.172**	−1.180*	0.00512	0.00847	44.02	247	0.531
PVT	−13.56	0.134***	0.320***	−29.25	0.622	−0.532***	−1.975**	−0.0276	0.0232*	647.6	247	0.423
QCG	−1.199	−0.0172	0.0902	−0.220	0.0565	0.0598	0.172	−0.0263	0.0114	5.215	239	0.043
REE	−4.336	0.167***	0.373***	−49.46*	0.187	−1.029***	−1.931	−0.0246*	−0.0216	1,141*	245	0.516
SJD	0.853	−0.0123	−0.00372	3.356	−0.0412	−0.119	−0.479	−0.0718	−0.0259*	−62.72	238	0.033
SJS	−1.220	−0.00811	0.648***	4.299	0.0562	0.164***	−0.819***	0.0322**	−0.00616	−92.21	247	0.612
SKG	−5.225***	0.0504**	−0.112	−8.785***	0.244***	−0.0615	0.266	−0.0175	−0.0165**	190.6***	198	0.242
STB	17.19	0.00356	0.268***	−5.672	−0.732	−0.347**	−1.411**	0.00177	−0.0419**	148.9	241	0.410
STG	2.176	−0.123*	−0.116	−21.37***	−0.109	0.0280	1.402*	−0.0781	0.0777**	424.2***	153	0.289
VHC	4.568***	−0.0414	0.672***	−0.717	−0.207***	0.000104	−0.574	0.0214	0.0204*	14.94	245	0.449
VNM	−50.22***	0.0195	0.0877	−116.5***	1.948***	−0.224	−0.502	−0.00333	0.0217	3,005***	193	0.577
VSC	−0.910	0.00409	0.268***	−4.211	0.0425	−0.122	−0.804	−0.00844	−0.00593	93.78	245	0.196

Notes: *,**,***Significant at 10, 5 and 1 percent levels, respectively